



SDMS Doc ID 2003546

Work Assignment No.: 168-9LA7.0
U.S. EPA Contract No.: 68-01-6939
Document No.: 279-RII-OP-DXRS-1

0000066

February 10, 1987

REM II Site Manager: James A. Goodrich

EPA Remedial Project Manager: Tom A. Mi

by:

Sr

Neil E. Botts

2-

D

R E M II

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES

U.S. EPA CONTRACT NO. 68-01-6939

**CAMP DRESSER & MCKEE INC.
PRIME CONTRACTOR**

FINAL

QUALITY ASSURANCE PROJECT PLAN
REMEDIAL INVESTIGATION

ORDOT LANDFILL SITE
GUAM

Work Assignment No.: 168-9LA7.0
U.S. EPA Contract No.: 68-01-6939
Document No.: 279-RI1-OP-DXRS-1

0000066

February 10, 1987

REM II Site Manager: James A. Goodrich

EPA Remedial Project Manager: Tom A. Mix

Prepared by: Neil E. Botts 2-13-87
Date
REM II Region IX, Quality Assurance Coordinator

Approved by: Michael C. Richards 2-13-87
Date
REM II Region IX Manager

received
acknowledged
Approved by: Nancy Lindsay 3/6/87
Date
USEPA Region IX Regional Project Officer

Approved by: Kent Kitchingman 3-2-87
Date
USEPA Region IX Quality Assurance Officer

CDM

environmental engineers, scientists,
planners, & management consultants

CAMP DRESSER & McKEE INC.

100 Spear Street, Suite 700
San Francisco, California 94105
415 495-5009

February 18, 1987

Ms. Rose Fong (X-8379)
U.S. Environmental Protection Agency
215 Fremont Street
San Francisco, CA 94105

Work Assignment No.: 168-9LA7
Project No.: EPA Contract No. 68-01-6939
Document No.: 279-R11-EP-DZPD-1
Subject: Ordot Landfill - Discussion of U.S. EPA Comments Dated November
6, 1986 on the Quality Assurance Project Plan

Dear Ms. Fong:

To assist you in your review of the recent submittal of the Final Ordot Landfill Quality Assurance Project Plan; provided below are specific discussions regarding your previous comments:

Comment 1a.: The proposed sampling and analytical schedule, at least for the preliminary investigation, needs to be provided. Table 14-1, Summary of Water Sample Data Collection, is not clear in its presentation of groundwater and springwater sampling.

Response: The proposed generic schedule for the activities has been provided as Figure 2-4. Specific sampling dates for the Phase I studies were added to Section 2.0. Table 14-1 has been revised to identify the number of samples collected at each station.

Comment 1b.: The intended uses of the data, (the correlation between the parameters selected and the objectives) must be stated. According to Section 5.0, enforcement is the general objective. However, not all of the measurements may be used in this way. For example, will the air sampling data derived from the field measurements for the purpose of site-safety planning also be used for enforcement?

Response: Section 5.0 has been modified to better reflect the objectives. The air program has been significantly modified to include just the use of field instruments for the collection of qualitative data. This activity is defined as a reconnaissance level investigation and will not be utilized for enforcement.

Comment 1c.: The air sampling scheme needs to be explained more fully, with respect to the rationale for selection of the analytes, the intended uses of the data (the Project Plan differs from the Sample Plan), the field measurements which are quantitative, and those which are qualitative. The methane studies

need more description, some of which is furnished by the Sample Plan and should be reproduced in the Project Plan. Why is this compound of importance? How will it be quantitated? It does not appear in Table 9-2, Air Sampling Methods Selection Matrix. Which parameters will be measured by the HNu, by the Gastech Hydrocarbon Survey meter, and by the OVA? How will odor analyses be conducted?

Response: As mentioned above, the air sampling effort has been significantly modified and only includes reconnaissance level data collection with field instruments. These data will be used to identify an appropriate approach to additional studies as a part of Phase II, if required.

Comment 1d.: In Table 4-1, data quality objectives need to be defined for all of the quantitative field measurements, such as the particulates.

Response: Data quality objectives for field instruments which provide both qualitative and quantitative data have been provided on Table 4-2.

Comment 2a.: Neither the Project Plan nor the Sample Plan addressed comment 6 of the June 25, 1986, Sample Plan review comments regarding the time of day during which air sampling will occur.

Response: The field personnel will be continually collecting air data using field instruments on each day that sampling occurs.

Comment 2b.: The source and preparation of the air sorbent tubes needs to be described as previously requested. The information in Table 14-2, Air Quality Sampling and Analysis, is not consistent with that in the Sample Plan, Section 6.6, Air Quality Monitoring, page VI-17.

Response: Air sorbent tubes will not be used during this investigation. All appropriate portions of the respective plans are now consistent.

Comment 2c.: Any changes in the analytical scheme which may result from review of the Sample Plan should also be incorporated into the Project Plan.

Response: The SAP was approved by U.S. EPA and the QAPP is consistent with the Final SAP.

Comment 2d.: Section 9.1, General Laboratory Requirements, Page 4. The preparation of glassware is according to CLP specifications.

Response: This section has been modified to indicate that all containers will be obtained from I-Chem. Also, all glassware will be cleaned according to CLP protocols.

Comment 3a.: Section 7.2.2, Chain-of-Custody, Page 4. Bullet 3 of the sub-section, Transfer of Custody and Shipment, must be corrected to agree with Section 7.2.5, Distribution of Copies.

Response: The discrepancy between the two cited sections was corrected.

Comment 3b.: Section 7.3, Field Notebooks, Paragraph 2, Sentence 1 is incomplete.

Response: This sentence has been corrected.

Comment 4.: Comment 11. Data Validation. The data validation criteria listed in Section 10.2, Data Validation, are not those used by EPA CLP. A reference which describes these criteria should be cited. On page 8 of this section, Item 13 is inappropriate to this project plan. In Section 10.2.1, Analytical Data, Region 9 data validation is performed using CLP criteria, or user-specified criteria in the case of SAS analyses. The Standard Operating Procedures for Evaluating Hazardous Waste Data should be added to the list of references.

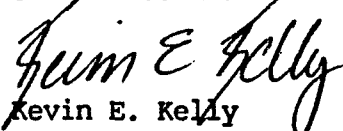
Response: The validation procedures identified in this section have been revised to follow CLP protocol. Page 3, Item 13, has been deleted.

Comment 5.: A "complete set" of field blanks and duplicates appropriate to the air monitoring program needs to be defined. What frequency of duplication of one entire downwind station is planned? One travel blank must be included in each shipping container holding VOC samples. In Section 12.2.1, Water Level Measurement, it is stated that while a minimum of two measurements will be made, only one will be recorded. In order to be considered replicates, all measurement should be recorded.

Response: A reconnaissance level air quality program using field instruments will be utilized as a part of the initial site investigation. As such, field blanks and duplicates for air samples will not be collected. As identified in Section V of the Final SAP, travel blanks will be included with each day of anticipated sample shipment. The section has been revised to state that both measurements will be recorded.

Sincerely,

CAMP DRESSER & McKEE INC.


Kevin E. Kelly

cc: T. Mix, U.S. EPA
J. Goodrich
PF 279 EP
FPC

FINAL
QUALITY ASSURANCE PROJECT PLAN
REMEDIAL INVESTIGATION

ORDOT LANDFILL SITE
GUAM

Work Assignment No.: 168-9LA7
U.S. EPA Contract No.: 68-01-6939
Document No.: 279-WP1-OP-DXRS-1

February 10, 1987

Prepared by:

Camp Dresser & McKee Inc.
2302 Martin Street, Suite 275
Irvine, California 92715

FINAL

QUALITY ASSURANCE PROJECT PLAN
REMEDIAL INVESTIGATION

ORDOT LANDFILL SITE
GUAM

Work Assignment No.: 168-9LA7.0
U.S. EPA Contract No.: 68-01-6939
Document No.: 279-RI1-OP-DXRS-1

February 10, 1987

REM II Site Manager: James A. Goodrich

EPA Remedial Project Manager: Tom A. Mix

Prepared by: *Neil E. Botts* 2-13-87
for Neil E. Botts Date
REM II Region IX, Quality Assurance Coordinator

Approved by: *Michael C. Richards* 2-13-87
for Michael C. Richards Date
REM II Region IX Manager

Approved by: _____ Date _____
Nancy Lindsay
USEPA Region IX Regional Project Officer

Approved by: _____ Date _____
Kent Kitchingman
USEPA Region IX Quality Assurance Officer

TABLE OF CONTENTS

<u>Section</u>	<u>Pages</u>	<u>Revision</u>	<u>Date</u>
A. Title Page	1	0	2/10/87
B. Table of Contents	5	0	2/10/87
1.0 INTRODUCTION/OVERVIEW	2	0	2/10/87
2.0 PROJECT DESCRIPTION	13	0	2/10/87
2.1 Site Description			
2.2 Site Investigation History			
2.3 Community Concerns			
2.4 Project Goals			
2.5 Project Schedule			
3.0 PROJECT ORGANIZATION AND RESPONSIBILITY	6	0	2/10/87
3.1 Program Organization			
3.2 Project Organization			
3.3 Quality Assurance Organization			
4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA	4	0	2/10/87
5.0 SAMPLING PROCEDURES	6	0	2/10/87
5.1 Development of a Sampling Plan			
5.2 Types, Locations, and Number of Samples			
5.3 Specific Sampling Objectives			
5.3.1 Ground Water Program			
5.3.2 Surface Water Program			
5.3.3 Air Quality Program			
5.4 General Sampling Protocols			
6.0 FIELD MEASUREMENTS	3	0	2/10/87
6.1 Atmospheric Gas/Vapor Monitoring			
6.2 Geologic Reconnaissance			
6.3 Ground Water Measurements			
6.4 Water Quality Parameters			
7.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES	7	0	2/10/87
7.1 Sample Type Delineation and Handling			
7.2 Custody Procedures and Documentation			
7.2.1 Traffic Report Form			
7.2.2 Chain-of-Custody Form			
7.2.3 Custody Seals			
7.2.4 Region IX Sample Data Sheet			
7.2.5 Distribution of Copies			

TABLE OF CONTENTS (cont.)

<u>Section</u>	<u>Pages</u>	<u>Revision</u>	<u>Date</u>
7.3 Field Notebooks			
7.4 Corrections to Documentation			
7.5 Sample Shipping			
8.0 EQUIPMENT CALIBRATION, MAINTENANCE, AND OPERATION	6	0	2/10/87
8.1 Inspection			
8.2 Written Operating Procedures			
8.3 Calibration			
8.4 Maintenance			
8.5 Master Equipment Control Record			
9.0 ANALYTICAL PROCEDURES	7	0	2/10/87
9.1 General Laboratory Requirements			
9.2 Data Requirements			
9.3 Laboratory Performance			
9.4 Analytical Data Review			
10.0 DATA REDUCTION, VALIDATION, AND REPORTING	7	0	2/10/87
10.1 Data Logging and Analysis			
10.2 Data Validation			
10.2.1 Analytical Data			
10.2.2 Field Measurement Data			
10.3 Final Reporting and Report Archival			
11.0 DATA MANAGEMENT AND DOCUMENT CONTROL	12	0	2/10/87
11.1 Introduction			
11.1.1 Purpose of Data Management			
11.1.2 Scope of Data Management Plan			
11.2 Data Management Personnel			
11.2.1 Data Management Organization			
11.2.2 REM II Site Manager			
11.2.3 Field Data Coordinator			
11.2.4 Project Librarian			
11.3 Document Control Procedures			
11.3.1 Introduction			
11.3.2 Document Types and Identifying Codes			
11.4 Field Data Management and Sample Control			
11.4.1 General Procedures			
11.4.2 Field Logbooks			
11.4.3 Sample Control			
11.5 Project Library Procedures			

TABLE OF CONTENTS (cont.)

<u>Section</u>	<u>Pages</u>	<u>Revision</u>	<u>Date</u>
11.5.1 General Library Procedures			
11.5.2 Filing Procedures and Confidential Files			
11.5.3 Confirmation that Documents are Filed in the Library			
11.5.4 EPA Enforcement and Classifications and Handling Procedures			
11.6 Computer Data Storage			
11.6.1 Use of Computer Data Bases			
11.6.2 Central Data Base			
11.6.3 Local Databases			
11.6.4 Data Backup			
11.7 Data Archiving			
12.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY	4	0	2/10/87
12.1 Quality Control Checks for Laboratory Activities			
12.2 Quality Control Procedures for Field Measurements			
12.2.1 Water Level Measurements			
12.2.2 Water Quality Parameters			
12.2.3 Air Quality Parameters			
12.3 Quality Control Checks for Deliverables			
13.0 PERFORMANCE AND SYSTEM AUDITS	2	0	2/10/87
13.1 System Audits			
13.2 Performance Audits			
14.0 DATA MEASUREMENT ASSESSMENT PROCEDURES	4	0	2/10/87
14.1 Accuracy			
14.2 Precision			
14.3 Completeness			
14.4 Comparability			
15.0 CORRECTIVE ACTION	1	0	2/10/87
16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT	1	0	2/10/87
<u>REFERENCES</u>	1	0	2/10/87
<u>APPENDICES</u>			
APPENDIX A Glossary of Terms	2	0	2/10/87

LIST OF TABLES

Table

2-1	Organic and Inorganic Constituents Associated with Military Landfills
2-2	Preliminary List of Deliverable Items - Phase I
4-1	Quality Control Criteria Objectives
4-2	Quality Assurance Objectives for Field Measurements
5-1	Site Investigation Protocol and Sampling Procedures
8-1	Equipment Maintenance Schedule
8-2	List of Critical Spare Parts
9-1	Close Support Laboratory Analytical Procedures
14-1	Summary of Sample Data Collection

LIST OF FIGURES

Figure

2-1	Site Location, Ordot Landfill Site
2-2	Site Location, Ordot Landfill Site
2-3	Sampling Location, Ordot Landfill Site
2-4	Schedule of Activities
3-1	Program Organization Chart
3-2	Project Organization Chart
3-3	Quality Assurance Organization Chart
10-1	Data Validation and Tracking System
11-1	Data Management Organization
13-1	Audit Flow Chart

DISTRIBUTION LIST

<u>TITLE</u>	<u>NAME</u>
REM II Quality Assurance Director	Rosemary Ellersick
REM II Deputy Quality Assurance Director	Lawren Phillips

DISTRIBUTION LIST (Continued)

<u>TITLE</u>	<u>NAME</u>
REM II Region IX Quality Assurance Coordinator	Neil E. Botts
REM II Region IX Regional Manager	Michael C. Richards
REM II Site Manager	James A. Goodrich
REM II On-Site Coordinator	Kevin Kelly
USEPA Region IX Regional Project Officer	Nancy Lindsay
USEPA Region IX Remedial Project Manager	Thomas A. Mix
USEPA Region IX Quality Assurance Officer	Kent Kitchingman

1.0 INTRODUCTION/OVERVIEW

This Quality Assurance Project Plan (QAPP) is provided as a deliverable for the Ordot Landfill Site, Guam in accordance with EPA Work Assignment Number 168-9LA7.0 as part of REM II Contract Number 68-01-6939. The QAPP addresses the requirements set forth in 40 CFR 30, including procedures to ensure the precision, accuracy, completeness, and representativeness of water, air and field chemistry data collected and generated during the course of this Remedial Investigation. Further, the QAPP provides the quality assurance requirements for data handling and manipulation and is intended to guide field, laboratory, and management personnel in all aspects of data collection, management, and control while on or off site.

The QAPP addresses U.S. Environmental Protection Agency (EPA) policies and guidelines that REM II Team Members are implementing as part of the REM II quality assurance/quality control (QA/QC) program. Quality assurance is defined as the integrated program designed for assuring reliability of monitoring and measurement data. Quality control is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process. Adherence to a centrally managed QA/QC program is a requirement of the REM II Contract. Each REM II team member has the responsibility to implement adequate procedures which assure that the precision, accuracy, completeness, and representativeness of its data and data products are known and documented. Quality Assurance procedures such as tracking, reviewing and auditing are implemented as necessary to ensure that all project work is performed in accordance with professional standards, EPA and other governmental regulations and guidelines, and specific project goals and requirements stated in the site Work Plan.

Standard operating procedures (SOPs) from private, state, and federal sources have been reviewed, modified where necessary, and incorporated by reference into this QAPP. These SOPs have been reviewed and approved by the EPA. Sample collection, field measurements, and field testing will be performed in accordance with these standard operating procedures. Analytical samples will be analyzed by laboratories within the EPA Contract Laboratory Program.

Quality control of field data, tabulations, analyses, computations and interpretation of field data will be performed by technical project personnel. Quality control of project deliverables will be provided by peer and senior staff review. Equipment used to take field measurements will be maintained and calibrated, and records of these kept, in accordance with established procedures. Quality assurance of all project activities will be maintained by periodic audits scheduled by the Quality Assurance Director.

Document control procedures will be implemented to keep track of documents used in this study. These procedures will be used to coordinate distribution, coding, storing, retrieving, and reviewing of all data collected. These procedures will also protect sensitive materials related to EPA enforcement activities that might be generated or obtained during the course of this study. Document control is also monitored by periodic quality assurance audits.

This QAPP has also been prepared in accordance with the requirements of the REM II Quality Assurance Program Plan (Document No. 999-QC1-RT-ACAB-3) and the following guidelines established by the USEPA and the REM II quality assurance program management, respectively:

- o USEPA. February 1983. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, EPA-600/4 - 83-004.
- o CDM Team. June 1985. Generic Guidance for Quality Assurance Project Plans, Document No.: 999-QC1-QA-AVXN-3.

2.0 PROJECT DESCRIPTION

The Ordot Landfill has been used for disposal of military and domestic wastes with few records available of waste types actually disposed. Fish kills, strong odors, discolored runoff and seepage associated with the Ordot Landfill indicate that contaminants from materials disposed in the landfill may be seeping from the landfill and potentially threatening the island's single source aquifer supplying the island's drinking water supply. Existing data show elevated metals in the groundwater, but no data have been collected to date to demonstrate the potential for emissions which may cause an air quality problem. The purpose of the Phase I studies described in this plan are to collect qualitative and quantitative data on organic and inorganic constituents associated with water, soil, and air samples from the site to better characterize the site.

A review of site investigations performed on other landfills indicate a number of common chemicals that are on the EPA's Target Compound List (TCL). These compounds are listed in Table 2-1. CDM recommends that samples be analyzed for the complete suite of TCL pollutants. The reconnaissance-level air quality program will center on performing qualitative analysis for volatile compounds using field instruments.

The purpose of the Phase I portion of the Remedial Investigation (RI) at the Ordot Landfill site is to collect the data required to refine the scope of work for the Phase II portion of the Remedial Investigation. Because existing data are insufficient to precisely define the scope of work for the Phase II Investigation, this QAPP is limited to Phase I activities only. This QAPP will be amended to include the scope of the Phase II Investigation once the Phase I Investigation is completed. An Initial Site Characterization Report will be prepared after the data collected during the Phase I Investigation are evaluated. This Quality Assurance Project Plan has been designed to assure the quality of data gathered and generated as well as the conclusions and recommendations reached from use of the data. This document is intended as both a guide to quality assurance activities and as a companion document to the Sampling and Analysis Plan

TABLE 2-1

ORGANIC AND INORGANIC
CONSTITUENTS ASSOCIATED WITH MILITARY LANDFILLS

Chlorinated Organics*

1,1-Dichloroethane
Tetrachloroethylene
Trichloroethylene
Methylene Chloride
Chloroform
Trichloroethane
Carbon Tetrachloride
Chlorobenzene
Dichlorobenzene
Bromodichloromethane
Dibromochloromethane
Bromoform
1,2-Dichloroethylene
1,1-Dichloroethylene
Polychlorinated Biphenyls

Aromatic Hydrocarbons*

Benzene
Toluene
Xylene
Ethylbenzene

Ketones*

Acetone
Methyl Ethyl Ketone

Extractable Organics

Phenol
Benzanthracene
Benzo (a) pyrene
Chrysene
Naphthalene

Pesticides/Herbicides

DDT
Chlordane
Aldrin/Dieldrin
Heptachlor
2,4,5-T
2,4,5-TP

Metals

Arsenic
Chromium
Copper
Lead
Nickel
Cadmium
Zinc

* These compounds are sufficiently volatile as to be an air quality concern.

and Site Health and Safety Plan. All these documents govern field and data collection activities and should be used concurrently.

The Island of Guam is located in the western Pacific region, approximately half way between Japan and New Guinea, and is the largest island in the Mariana Island Group. Guam has an area of about 212 square miles, is approximately 30 miles long, and ranges between 4 and 11.5 miles wide (Figure 2-1). The island has two very distinct physiographic divisions. The southern half is composed of rugged volcanic upland and the northern half of the island is characterized by a limestone plateau. The majority of Guam's drinking water supply comes from groundwater produced from the sole-source limestone aquifer in the northern part of the island. The Ordot Landfill is located in the northern part of the volcanic upland area, near the divide between the limestone and volcanic provinces (Figure 2-2).

2.1 SITE DESCRIPTION

The Ordot Landfill has received the majority of the wastes generated on the island since before World War II. It has been operated more as a dump than as a municipal landfill. Only during the last ten years has cover material been placed over refuse, and even now waste cells are not uniform and cover material is minimal. The landfill is presently operated by the Guam Department of Public Works and receives municipal and military refuse.

The landfill is known to have received hazardous wastes during its history, which includes the Japanese occupation of Guam during World War II. The site is known to have received PCB contaminated oils from transformers, munitions, and hazardous wastes commonly used in households and light industry. However, records do not exist regarding when, how much, and what type of hazardous wastes were disposed of at the landfill.

The uncontrolled disposal of hazardous and other wastes at the Ordot Landfill has resulted in possible contamination of surface waters which flow unabated onto and from the site. The surface water, including a large spring (Figure 2-2) has resulted in leachate emanating from various

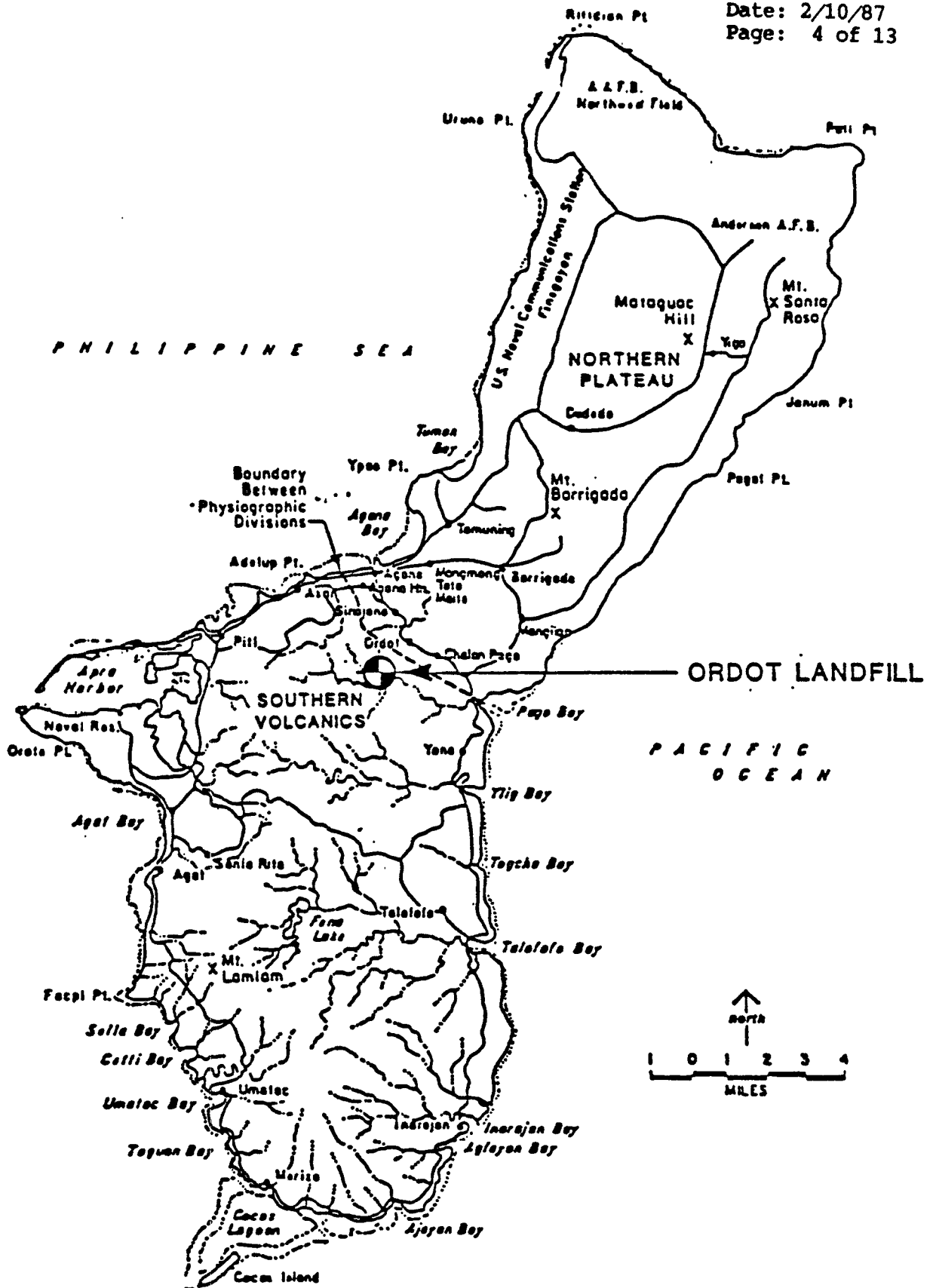
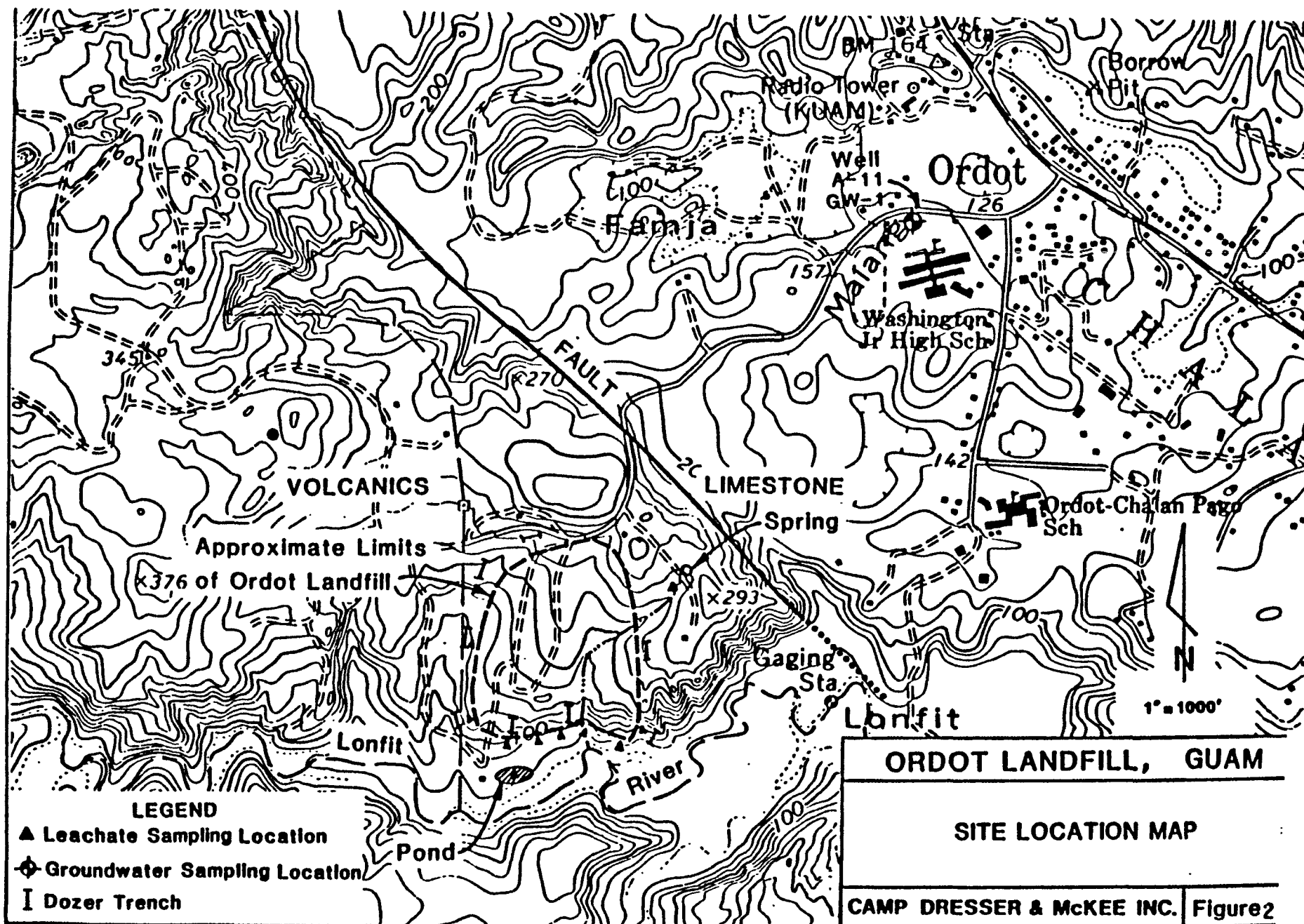


Figure 2-1
LOCATION OF ORDOT LANDFILL
ISLAND OF GUAM



From Feb, 10 1987

QAPP

- Please photocopy
with this post-it
on the page !!!

5-23-02 Melinda W

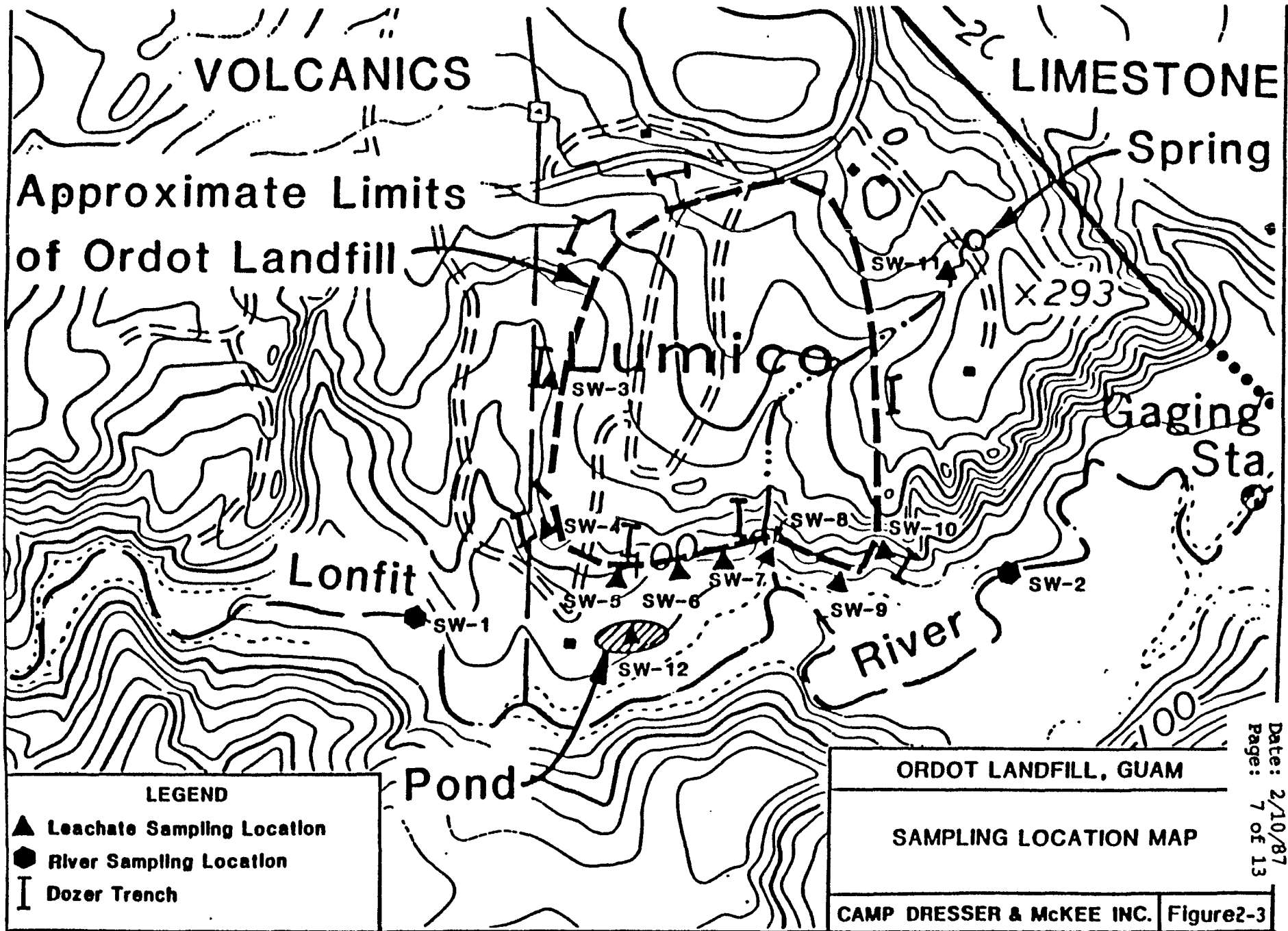
locations around the landfill. This leachate leaves the landfill site either in surface runoff or from small springs. The runoff eventually enters a stagnant pond or the Lonfit River (Figures 2-2 and 2-3). The leachate that discharges to the river eventually enters Pago Bay on the east side of the island. Fish kills have been reported in Pago River, downstream of the site. Contamination of marine life and recreational areas in Pago Bay may be sources of potential public health problems and, therefore, it is proposed that leachate and surface water sampling be conducted in the Site area.

An additional possible public health problem due to the Ordot Landfill is the potential contamination of the sole-source aquifer in the area. As previously described, the Ordot Landfill is thought to be located in the southern physiographic province where volcanic bedrock exists. However, the landfill is located very close to the limestone unit and, consequently, there is some concern that there is a potential for contaminating the limestone aquifer. There is also some concern that the landfill directly overlies the limestone aquifer. Contamination of the aquifer would result in a serious public health problem as it is the primary drinking water source for the island. Due to these circumstances, limited geologic reconnaissance and groundwater sampling efforts are proposed for the area.

2.2 SITE INVESTIGATION HISTORY

Since 1979, the Guam Environmental Protection Agency (GEPA) has conducted periodic sampling and analyses of four surface water monitoring stations on the Lonfit and Pago Rivers and three leachate monitoring stations at the landfill. Samples were analyzed for selected heavy metals and pesticides. With a few exceptions, most constituent concentrations are below action levels.

In addition to the ongoing GEPA monitoring of surface water and leachate, three studies have been conducted at Ordot Landfill. The first was commissioned by GEPA for the Guam Department of Public Works (GDPW) and was conducted by GMP Associates in 1981. The study was a master plan for the



LEGEND

- ▲ Leachate Sampling Location
- River Sampling Location
- I Dozer Trench

ORDOT LANDFILL, GUAM

SAMPLING LOCATION MAP

CAMP DRESSER & McKEE INC. Figure2-3

Section: 2.0
Revision: 0
Date: 2/10/87
Page: 7 of 13

landfill and recommended changes in both the way the landfill is managed and the way the landfill is operated. It also recommended alternative ways that the site could be expanded and eventually closed. Very few of the management and operational recommendations made by GMP Associates were ever implemented by GDPW, primarily because of budget constraints.

The second study was conducted by Black and Veatch Engineers for the U.S. EPA in 1983. This study was done under Superfund contract number 68-03-1614 (Work Assignment No. Z-3-12). It was a reconnaissance-level study done as part of a larger study of potential hazardous waste sites in the Trust Territories. The project team spent one day sampling several leachate, groundwater, and surface water sites in and near the site area. Samples were analyzed for Priority Pollutants at various labs in the continental United States. The results of the analyses were not published in their report, however, they stated that "... low levels of contamination are contributed by the Ordot Landfill" and that nickel concentrations above action levels were noted at nearby Water Well No. A-11 (which is located in the main limestone aquifer north of Ordot Landfill). However, they recommended that no remedial action be taken at Ordot Landfill, even though the source of contamination was not identified for the well and the potential for future contamination of surface water and/or groundwater by unknown wastes buried in the landfill was not addressed.

The third study, which is currently underway at Ordot Landfill, is being conducted by the Water and Energy Research Institute (WERI) under a U.S. Geological Survey (USGS) contract. WERI is affiliated with the University of Guam. The WERI is attempting to install groundwater monitoring wells at the toe of the landfill in order to sample groundwater for organic contamination. Samples have not been collected at the time of this writing. Their method of drilling by hand auger and jetting (using leachate accumulating in the nearby pond) will probably yield sampling wells which will not be satisfactory for the work to be conducted during the RI.

2.3 COMMUNITY CONCERNS

There are no organized citizen's groups identified at this time. Contamination of marine life and recreational areas in Pago River and in Pago Bay are potential public health problems. The main area of concern stated by Guam health officials is the potential contamination of the sole-source aquifer in the area, resulting in a contaminated community water-source basin.

2.4 PROJECT GOALS

As indicated above, several potential health problems exist due to poor surface runoff control present at the Ordot Landfill. These poor controls could potentially result in the contamination of both groundwater and surface water supplies in the area. In order to better understand the potential for contamination, a Phase I Investigation has been proposed for the area as part of the RI. The Phase I Investigation will result in the collection of (1) leachate samples, (2) surface water samples, (3) reconnaissance-level air sampling with field instruments, and (4) a groundwater sample. This information will be utilized to develop an Initial Site Characterization Report for the site. Furthermore, the development of a data base which characterizes the leachate, surface water, and groundwater quality will be important for additional efforts to be conducted under the Phase II Investigation. In addition, the air sampling effort will indicate whether a more detailed and focused air quality sampling may be required as a part of Phase II studies.

To evaluate the presence and extent of contamination at the Ordot Landfill site, the Phase I Investigation will be conducted. The primary objective of this Investigation will be to identify and define the problems and to refine a scope of work for the Phase II Investigation. The rationale for field water and leachate sampling will be to identify contaminants and respective concentrations, so that an assessment of the problem can be made. The data collected will be used to determine the level of protection required during the Phase II Investigation and to estimate sources of

contaminants, potential pathways, and exposure to surrounding population. The specific activities to be performed as a part of the Phase I Investigation are listed below.

- o Prepare project plans for Phase I Investigation
- o Conduct Phase I Investigation
 - Determine quality of leachate leaving the boundaries of the landfill.
 - Determine the water quality of the Lonfit River, upstream and downstream of the landfill.
 - Determine the water quality of the groundwater in the limestone aquifer in the vicinity of the Town of Ordot.
 - Perform a reconnaissance-level geologic investigation in the vicinity of the landfill in order to determine the bedrock unit underlying the landfill.
 - Perform a reconnaissance-level air survey using field instruments to portray field conditions and determine potential emissions.
- o Prepare Initial Site Characterization Report
- o Refine scope of Work and Project Plans for the Phase II Investigation

All data and documents collected during the course of the Phase I Investigation will be controlled as defined in the Data Management Plan. The plan will ensure proper chain of custody, maintenance of project library, development of a computerized data based and control of archived materials. This plan is described in Section 11.0.

2.5 PROJECT SCHEDULE

The schedule for completing the Ordot Landfill Phase I Investigation is presented on Figure 2-4 (Project Schedule). The initial sampling effort is scheduled to occur during March 9 through 13, 1987. This investigation will take approximately five months to complete. Figure 2-4 also indicates the approximate times when Technical Review Committee meetings and QA/QC audits will be conducted. A Schedule of Deliverables which indicates when

key deliverables will be reviewed internally and by whom, and when they will be submitted to the EPA for review and final approval will be prepared once funding for the RI has been received.

A systems audit will be performed near the completion of each major phase of the project by the Region IX Quality Assurance Coordinator. The scope of Phase II Investigation is not refined to the point that an audit schedule can be developed for that portion of the work. Under the REM II program, a performance audit is conducted for 10 percent of REM II sites. It is not known at this time whether a performance audit will be performed on the Ordot site Remedial Investigation activities.

A preliminary list of deliverable items is included as Table 2-2. Required reviews and/or approvals are noted (in accordance with Technical Operations Manual requirements).

FIGURE 2-4
 REM II
 SCHEDULE OF ACTIVITIES
 ORDOT LANDFILL, GUAM

Site Number: 279

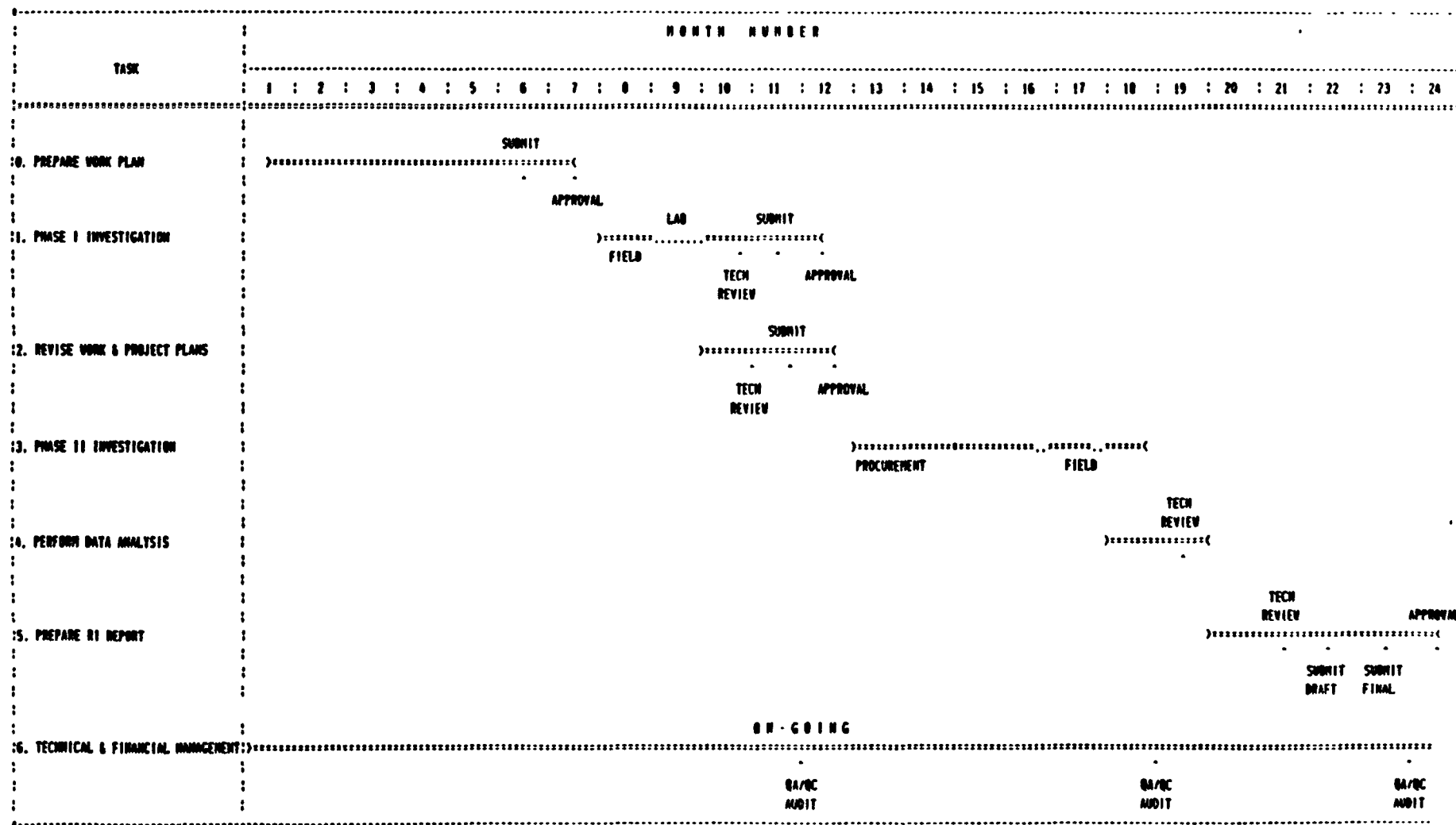
Site Name: ORDOT LANDFILL, GUAM

UA Code: 160.9LA7.0

Site Manager: J. GOODRICH

Date: DECEMBER 31, 1985

Phase: REMEDIAL INVESTIGATION: Phase I & II



REVISED: MARCH 6, 1986

Section: 2.0
 Revision: 0
 Date: 2/10/87
 Page: 12 of 13

Table 2-2

PRELIMINARY LIST OF DELIVERABLE ITEMS

Phase I

Document	Review/Approval
Phase I Work Plan	RM, SM, TRC, FAM, RPO, RPM
Phase I Quality Assurance Project Plan	QAC, RM, RPO, QAO
Project Plans:	SM, RM, TRC, HSM
Sampling Plan	
Health and Safety Plan	
Data Management Plan	
Initial Site Characterization Memo	SM, RM, TRC, RPM
<hr/>	
Phase II Work Plan	(Same as Phase I)
Phase II QAPP	(Same as Phase I)
Phase II Project Plans	(Same as Phase I)
Remedial Investigations Draft Reports	SM, RM, TRC, RPM
Remedial Investigations Final Report	SM, RM, TRC, RPM
* In accordance with the Technical Operations Manual (April 1985)	
Legend:	
RM	Region Manager
SM	Site Manager
FAM	Finance and Administration Manager
RPO	Regional Project Officer - EPA
RPM	Remedial Project Manager - EPA
QAC	Region Quality Assurance Coordinator
QAO	Quality Assurance Officer - EPA
HSM	Health and Safety Manager
TRC	Technical Review Committee/Peer Review

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

3.1 PROGRAM ORGANIZATION

The REM II program and quality assurance organization and responsibilities are discussed in detail in Section A of the REM II Quality Assurance Program Plan. The program organization chart is reproduced as Figure 3-1. It shows quality assurance organized independently of technical operations, which is responsible for quality control.

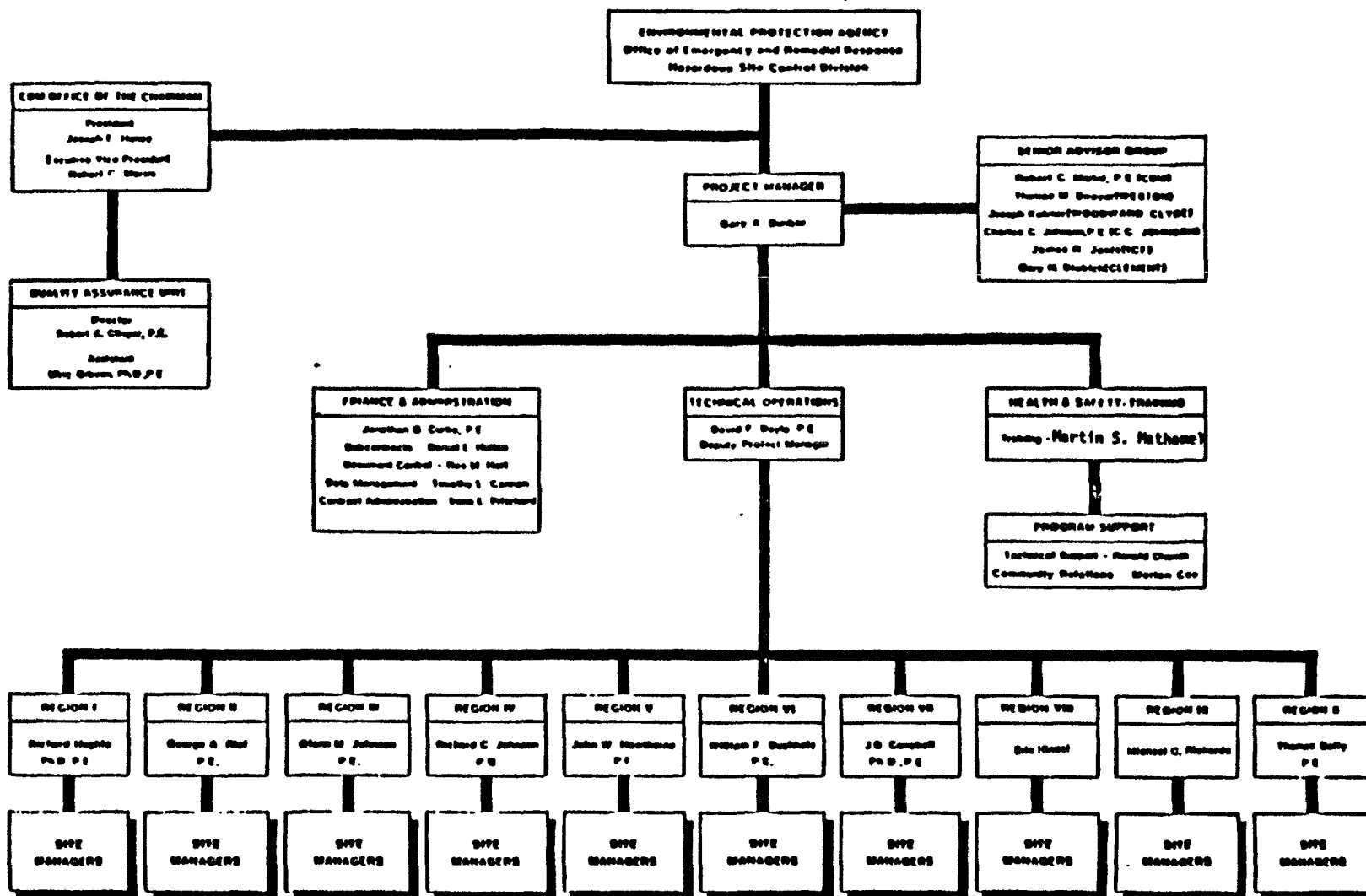
3.2 PROJECT ORGANIZATION

The project organization is presented as Figure 3-2.

Primary responsibility for all quality control activities relating to the Ordot Landfill is undertaken by the Site Manager who is answerable to the Technical Operations Manager through the Regional Manager. The Regional IX Manager, Michael C. Richards, will be responsible for the Ordot Landfill study. The Site Manager for the Ordot Landfill is James A. Goodrich and the On-site Coordinator is Kevin Kelly.

The Site Manager, James A. Goodrich, will be responsible for directing all day-to-day activities relating to the Ordot Landfill Remedial Investigation. In addition to site management activities, it will be his responsibility to ensure that quality control checks are performed for all field activities, data analyses, and deliverables and that technical reviews are performed as scheduled.

The On-Site Coordinator, Kevin Kelly, will also serve in a quality control capacity, bearing the responsibility for the quality of field data. It will also be the responsibility of the On-Site Coordinator to ensure that the Sampling and Analysis Plan is implemented, as approved by EPA and REM II personnel.



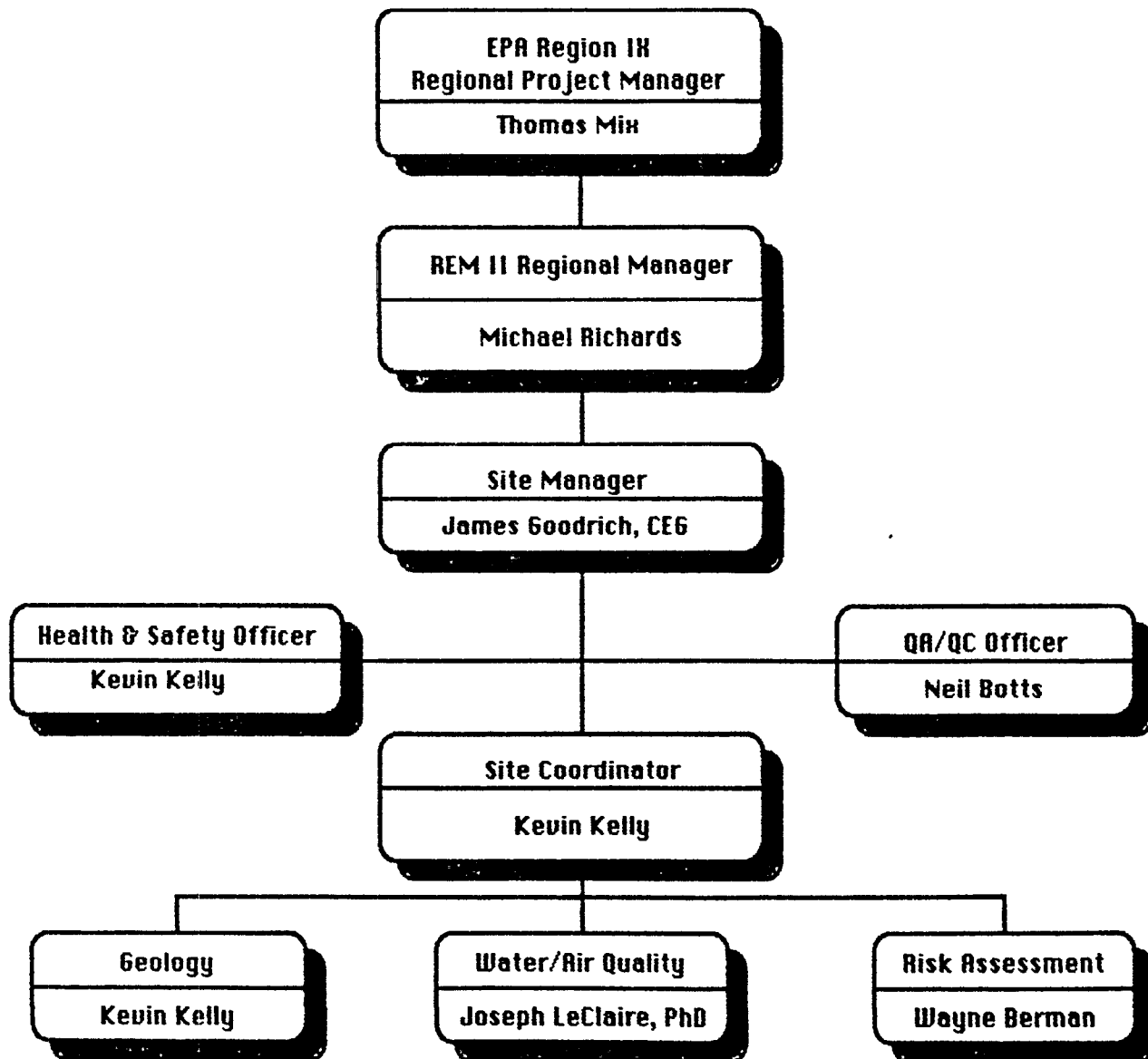
Section: 3.0
Revision: 0
Date: 2/10/87
Page: 2 of 6

Figure 3-1 Program Organizational Chart

FIGURE 3-2

PROJECT ORGANIZATION CHART

ORDOT LAND FILL, GUAM
PHASE I INVESTIGATION



3.3 QUALITY ASSURANCE ORGANIZATION

The REM II quality assurance organizational chart is presented in Figure 3-3. The Quality Assurance Director (Rosemary Ellersick) and her Deputy (Lawren Phillips) answer directly to CDM corporate management for the quality assurance of all REM II projects. The Quality Assurance Director (QAD) exercises her responsibilities at the regional level through the Regional Quality Assurance Coordinators (QAC). The QAC for Region IX in which the Ordot Landfill Site is located is Neil E. Botts.

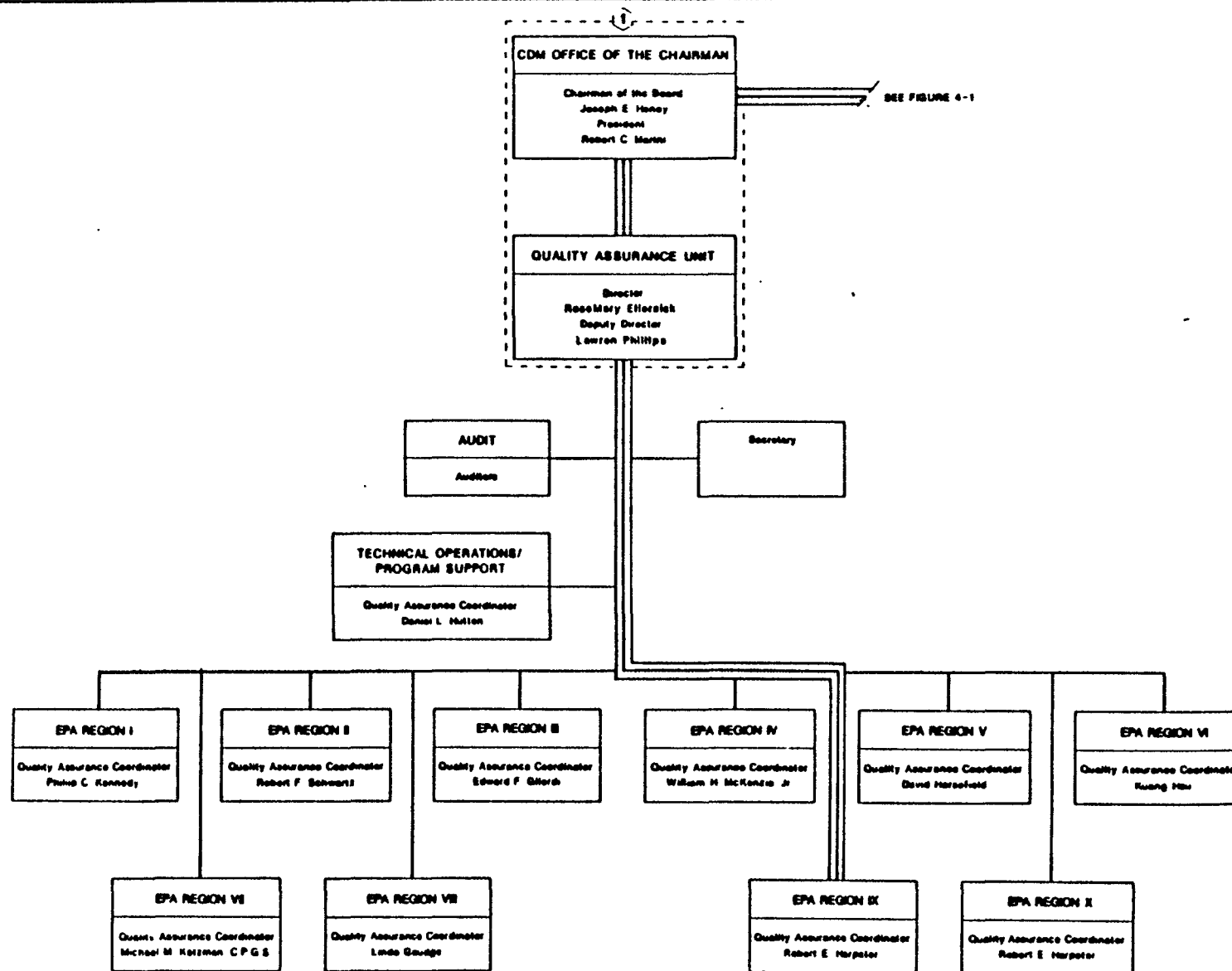
Responsibilities of the QAD and QAC are discussed in detail in Sections A.5.3 and A.5.5, respectively of the REM II Quality Assurance Program Plan. Summaries of these responsibilities are presented below.

Quality Assurance Director

The Quality Assurance Director is responsible for all aspects of the Quality Assurance Program Plan. Responsibilities include approval of quality assurance procedures, conducting system and performance audits, and seeing that quality assurance personnel are trained. The Deputy Quality Assurance Director will assist her in the execution of her duties.

The Quality Assurance Director's specific responsibilities include:

- 1) Planning, implementing, and administering the quality assurance program;
- 2) Interfacing with EPA on quality assurance matters;
- 3) Reviewing procedures at least once a year with EPA to ensure consistency with quality assurance objectives and continued conformance with applicable regulations;
- 4) Auditing the overall performance of the quality assurance program, and developing a plan for regularly monitoring the quality aspects of hazardous waste management activities. The plan shall cover a major cross section of hazardous waste activities to ensure program control of documents and implementation of procedures. Auditors will be provided as needed;
- 5) Preparing a monthly report on the status of the quality assurance program for Chairman and the National Project Manager (see Figure



Project No.

Camp Dresser & McKee Inc.

QUALITY ASSURANCE ORGANIZATIONAL CHART

Figure
3-3

Section: 3.0
Revision: 0
Date: 2/10/87
Page: 5 of 6

3-3). This report will include summaries of audit findings and corrective actions, and progress in implementing the quality assurance program;

- 6) Working with all levels of personnel to identify and eliminate potential quality assurance problems;
- 7) Supporting corporate quality assurance audits of hazardous waste management activities.

Regional Quality Assurance Coordinator

The Regional Quality Assurance Coordinators are responsible for all procedures and tasks pertaining to quality assurance in their respective regions and report to the Quality Assurance Director (and her Deputy) for quality assurance activities.

Specific duties include:

- 1) Monitoring project activity to verify compliance with quality assurance plans;
- 2) Reviewing appropriate sections of Work Plan documents for approval;
- 3) Reporting periodically to the Quality Assurance Director on quality assurance activities;
- 4) Providing quality assurance for all technical deliverables produced in the region. Quality assurance will be achieved through routine audits of regional work assignments.

4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Quality assurance objectives for measurement data are usually expressed in terms of accuracy, precision, completeness, representativeness and comparability. Definitions of these characteristics are as follows:

- o Data Quality: The totality of features and characteristics of data that bear on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.
- o Accuracy: The degree of agreement of a measurement (or an average of measurements of the same thing), X , with an accepted reference or true value, T . This is usually expressed as the difference between the two values, $X-T$, or the difference as a percentage of the reference or true value, $100 (X-T)/T$, and sometimes expressed as a ratio, X/T . Accuracy is a measure of the bias in a system.
- o Precision: A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."
- o Completeness: A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.
- o Representativeness: The degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- o Comparability: The confidence with which one data set can be compared to another.

Initial site sampling will be exploratory in nature. The sampling will be conducted to identify the nature of contamination at the landfill so that a more extensive remedial investigation can be planned. The Quality Assurance objectives of the Phase I Investigation of the RI are presented in Table 4-1. The field measurement quality assurance objectives are provided in Table 4-2. The objectives for the analytical laboratory are presented in the CLP contract with the EPA.

TABLE 4-1

QUALITY CONTROL CRITERIA OBJECTIVES^a

Sample Matrix	Parameters	Detection Limit	Precision Goals (RPD of Blind Duplicates)	Accuracy Goals (Matrix Spike Percent Recovery)	Completeness	Comparability
Water	RAS Volatiles Organics	A	+ 20%	75-125	85%	ug/l
	RAS Extractables	A	+ 20%	75-125	85%	ug/l
	RAS Pesticides	A	+ 20%	75-125	85%	ug/l
	Dissolved Metals	B	+ 20%	75-125	90%	ug/l
	Total Metals	B	+ 20%	75-125	90%	ug/l
	Cyanide	B	+ 20%	75-125	85%	ug/l

^a Quality Control Criteria for internal laboratory quality control checks is as specified in the CLP IFB for organics (WA8J-J680) and inorganics (WA85-J838).

A Detection limits, specified in the CLP IFB for organics (WA85-J680).

B Detection limits, specified in the CLP IFB for inorganics (WA85-J838).

Section: 4.0
Revision: 0
Date: 2/10/87
Page: 2 of 4

TABLE 4-2
QUALITY ASSURANCE OBJECTIVES FOR FIELD MEASUREMENTS

Measurement Parameters	SIPM Reference	Readability	Instrument Accuracy	Completeness
Salinity	5617002	.2 0/00 on 0-40 0.00 range	Above 4°C \pm 0.9 0/00 at 40 0/00 and \pm 0.7 0/00 at 20 0/00 plus probe accuracy of \pm 2.0% (0/00 = parts per thousand)	90%
Temperature	5617002	\pm 0.15°C at -2°C to \pm 0.37°C at 45°C	\pm .1°C at -2°C; \pm 0.6°C at 45°C plus probe accuracy of \pm 2.0%	90%
Conductivity	5617002	2.5 umhos/cm on 500 range, 25 umhos/cm on 5000 range, 250 umhos/cm on 50,000 range	\pm 2.5% max. error at 500, 5000 and 50,000 umhos/cm plus probe. \pm 3.0% max. error at 250, 2500 and 25,000 plus probe accuracy of \pm 2.0%	90%
pH	5617003	NA	\pm 0.05 pH units	90%
HNu PI 101	5607001	\pm 1%	Accuracy variable (see SIPM) Range 0.1 to 2000 ppm Detection 0.1 ppm	90%
Dissolved Oxygen	5617001	0-20 mg/l	\pm 1%	90%
Gastechtor	5607004	0-20% - Oxygen 0-500 ppm - Combustible Gas/Vapor	\pm .1 of Reading	90%
OVA	5607003	0-1,000 ppm - Organic Vapor	0.1 ppm (methane)	90%
GCA MINIRAM	5607021	0.01-100 mg/m ³ - Airborne particulates	\pm 0.03 mg/m ³	90%

*See the SIPM for discussion

Section: 4.0
Revision: 0
Date: 2/10/87
Page: 4 of 4

This Quality Assurance Project Plan has been designed to implement the procedures necessary to maintain a consistent quality of technical products. This consistency will be accomplished through the formal standardization and documentation of field techniques and through additional activities described in the remaining sections of this document.

5.0 SAMPLING PROCEDURES

General programmatic sampling requirements are provided in Sections E and L of the REM II Quality Assurance Program Plan. Section E requires that sampling and other activities which affect data quality must be conducted in accordance with formally documented procedures. It refers to the Standard Operating Procedures (SOPs) established in the Site Investigation Procedures Manual (SIPM) and specifies that all other procedures must be approved by the Technical Operations Manager prior to their use. Section L pertains to the handling, storage, and shipping of samples in accordance with procedures established in the Technical Operations Manual and the SIPM.

This section presents an overview of the sampling program to be conducted at the Ordot Landfill site during the Phase I Investigation and describes routine procedures to be followed by all site personnel performing field measurements, testing, and collection of samples. The specific SOPs, including REM II Site Investigation Procedures Manual (SIPM) document control numbers, to be implemented at the site are presented in Table 5-1. Any procedures developed specifically for this project will take precedence over the procedures provided in the SIPM.

Several field activities will be conducted during the Phase I Investigations. Surface water, groundwater, and leachate samples will be taken in and around the site to determine the general quality and quantity of leachate generated at the site. Trenching and geologic mapping will be done in and around the site to determine the presence and nature of limestone adjacent to the site. Reconnaissance-level air sampling will be conducted using field instruments, to estimate the potential for emissions from the site. These data will be qualitative and used to identify whether a potential air quality problem exists at the site. If significant emissions are detected and identified, then a more focused and detailed air quality monitoring program can be developed and implemented during Phase II. The procedures presented in this section and Section 7.0 are designed to ensure that all samples collected are consistent with project objectives. This means that: (a) samples are identified, preserved, and transported in a manner such that data are representative of the actual site conditions, (b)

TABLE 5-1

SITE INVESTIGATION PROTOCOL AND SAMPLING PROCEDURES

General Sampling Procedures	Method Number
Procedure for Use and Maintenance of Field Notebooks	5621004
Sample Classification, Handling and Shipment	5622001
Sample Identification procedure	5622002
Sample Bottle Preparation, Sample Preservation, and Maximum Hold Times	5622006
General Quality Assurance Procedures	Method Number
Equipment and Instrument Calibration and Maintenance, General Requirements	6600001
Samples Collected for Quality Control Purposes	5622007
Chain-of-Custody	5622005
Procedure for Use and Maintenance of Field Notebooks	5621004
Calibration and Maintenance Procedure for Yellow Springs Instrument (YSI) Model 57 Dissolved Oxygen Meter	6617001
Calibration and Maintenance Procedure for Yellow Springs Instrument (YSI) Model 33 S-C-T Meter	6617002
Calibration and Maintenance Procedure for HaakeBuchler pH Stick	6617003
Calibration and Maintenance Procedures for GCA MINIRAM Particulate/Aerosol Monitor PDM-3	66077021
Calibration and Maintenance Procedures for Gastechtor Hydrocarbon Surveryor, Model 1314	6607604
Calibration Procedures for the HNu PI-101	6607001
Calibration and Maintenance Procedure OVA - Model 128	6607003

TABLE 5-1

SITE INVESTIGATION PROTOCOL AND SAMPLING PROCEDURES (cont.)

Activity	Procedure	Method Number
Field Water Quality	Procedure for Determination of Dissolved Oxygen, YSI Model 57 DO Meter	5617001
	Operation procedure YSI Model 33 S-C-T Meter (Salinity, Conductivity, Temperature)	5617002
	Operation Procedure for HaakeBuchler pH Stick	5617003
Groundwater Sample Collection	Procedure for Determining Temperature of Groundwater	5617004
	Procedures for Water Level Measurement	5619007
	Procedure for Well Evacuation	5619008
	Considerations for Sample Withdrawal from Wells	5619009
Air Monitoring	Procedure for Filtration of Samples	5617007
	Operation Procedure for HNU Model PI 101 Photoionization Analyzer	5607001
	Operation Procedure for Gastechtor Hydrocarbon Survey, Model 1314	5607004
	Operation Procedure Century Portable Organic Vapor Analyzer (OVA) Model 128	5607003
	Procedure for Operation of the GCA MINIRAM Particulate/Aerosol Monitor Model PDM-3	5607021
Surface Water/Leachate Sample Collection	Surface Water Sampling Guidelines	5620001

information is not lost in sample transferral, and (c) data from the CLP program can be used for enforcement purposes. This data will ultimately be used to determine the extent and nature of contamination and to support the feasibility study.

5.1 DEVELOPMENT OF A SAMPLING PLAN

The SAP follows guidelines and requirements as established by EPA Region IX. The SAP has been approved by EPA and was previously transmitted to EPA under separate cover. The SAP includes and/or describes the following:

- o Objectives of the sampling effort
- o Sample locations and selection criteria
- o Required field instruments and sampling equipment, including containers used and methods of sample preservation
- o Site-specific sampling methodology
- o Site-specific testing methodology
- o Decontamination procedures
- o Number of samples to be taken and sample numbering system
- o Types of field measurements required
- o Data requirements and analytical procedures to be used
- o Storage and shipping methods
- o Chain-of-custody procedures

5.2 TYPES, LOCATIONS, AND NUMBER OF SAMPLES

The types, locations, and number of samples to be collected are determined based on available background data and are specified in Section 14. For example, in order to characterize the leachate emanating from the site, up to ten samples will be collected from the leachate streams. Also, the potential impact of the leachate on the Lonfitt River will be evaluated through the collections of samples upgradient and downgradient of the landfill. In addition, the potential for groundwater contamination will be

evaluated through the collection of a sample from a well completed in the limestone aquifer located near the landfill. Surface water, groundwater, and leachate samples will be collected during the Phase I Investigation. Chemical analyses to be performed include volatile and semi-volatile organics, pesticides, metals, and cyanide. The analytical procedures to be performed by the EPA contract laboratories are outlined in Section 9.0 of this QAPP.

The location of each sample is clearly defined in the Sampling and Analysis Plan on-site maps. Specific air sampling locations cannot be identified until investigators enter the field. Selection of sampling point locations will be made in accordance with prevailing wind directions during the time of the field investigation. Air sampling will be conducted with field instruments by transecting the landfill area. Whenever possible, sampling locations will be documented by photographs. The sample location and type of sample will be indicated on a site sketch and in a field notebook.

5.3 SPECIFIC SAMPLING OBJECTIVES

5.3.1 GROUND WATER PROGRAM

- o Collect water sample and determine water level from the monitor well at Washington Jr. High School (Well No. A-11).
- o Analyze for RAS volatiles, semi-volatiles, pesticides, and metals.

5.3.2 SURFACE WATER/LEACHATE PROGRAM

- o Field-verify drainage patterns and structures in the study area.
- o Collect and analyze 12 water samples from various locations around the landfill.
- o Analyze for RAS volatiles, semi-volatiles, pesticides, and metals.

In addition to detailing the field methods involved in completing the above tasks, the SAP describes in detail all sample collection, preservation, and handling techniques.

5.3.3 AIR QUALITY PROGRAM

- o Analyze by direct reading instruments

5.4 GENERAL SAMPLING PROTOCOLS

Prior to undertaking sampling or drilling operations, CDM will establish a materials storage area at the site.

Personnel decontamination equipment necessary to perform operations will be provided as described in the Site Health and Safety Plan (SHSP). The sampling activities will involve the use of disposable equipment or the collection will be conducted in a fashion which does not require decontamination (e.g., sample containers will be used directly for collection of leachate samples, and only one groundwater sample will be collected, etc.) Therefore, decontamination for the sampling effort will not be required. CDM will also have sufficient safety equipment of adequate quality and level (Levels C and D) to protect personnel during site activities. Safety procedures to be used in the field investigations are described in the SHSP prepared by CDM.

All containers for water samples which are to be sent to through the Contract Laboratory Program will be provided by EPA through the Superfund Sample Bottle Repository. Field instruments used for air sampling will be obtained from the REM II equipment inventory.

6.0 FIELD MEASUREMENTS

Measurements of water and air parameters will be made in the field during the course of the Phase I Investigation. This section presents the routine procedures that will be implemented to conduct field measurements. Specific procedures to be followed, including the REM II Site Investigation Procedure Manual document control numbers, are listed in Table 5-1 and are presented in the Sampling and Analysis Plan.

The methods presented in this section and in the SAP are intended to ensure that field measurements are conducted in a similar and consistent manner by all individuals involved. By using standard procedures and protocols, the data collected by the sampling teams will carry out the objectives of the Work Plan.

6.1 ATMOSPHERIC GAS/VAPOR/PARTICULATE MONITORING

The presence and relative concentrations of organic vapors and gases, including methane, and of particulate matter in the atmosphere in the breathing zones will be measured with HNu and OVA instruments, a respirable dust monitor, and an explosivity monitor. These instruments will be used primarily to select appropriate levels of protection as described in the Site Health and Safety Plan, although transects of the site and along the boundaries will also be conducted to determine potential emissions. They will also be used as part of the overall site screening process and to detect any organic vapors in the well sample.

6.2 GEOLOGIC RECONNAISSANCE

One of the objectives of the Phase I Investigation is to determine the composition of the bedrock material in the area directly surrounding the landfill. To achieve this objective, a bulldozer will be used to clear the vegetation and excavate trenches for evaluation of the bedrock surface. The locations of the trenches are provided in Figure 3 of the Sampling Plan. The evaluation will take place in the field and noted in the site

logbook. Following the evaluation, the excavated area will be back-filled and leveled, but not revegetated.

Once a trench has been excavated, the soil material overlying the bedrock will be visually described and entered into the field logbook. It is anticipated that a weathered soil horizon will exist to a depth of approximately 3 to 4 feet. The detailed description of the soil material will include the following information:

- o Stratification
- o Color utilizing Munsell Color notation
- o Texture using USDA or Unified Soil Classification System
- o Density or consistency
- o Odor
- o Relative moisture content
- o Relative porosity and permeability

6.3 GROUND WATER MEASUREMENTS

The procedures used for obtaining water level measurements will vary according to the type of well being measured. The detailed procedure for water level measurement at the Washington Jr. High School well is included in Section 6.4 of the SAP.

6.4 WATER QUALITY PARAMETERS

Conductivity, temperature, and pH measurements will be made at each water sampling location at the time of sample collection. These field measurements will be made on a sample which is separate and discrete from the sample collected for laboratory analysis. A conventional pH meter with a combination gel-filled electrode or equivalent will be used for field pH determinations. Temperature will be measured using a mercury thermometer. A combination salinity-conductivity-temperature meter or equivalent measurement device will be used for the remaining field parameter measurements. All

measurements will be recorded in the field notebook or on an appropriate form.

All instruments will be calibrated to ensure accuracy (see Section 8.0). All probes will be thoroughly rinsed with distilled water prior to any measurements.

A representative water sample will be collected in accordance with procedures specified in the Sampling and Analysis Plan. These procedures have been developed to insure that collection methods result in samples that accurately represent the media being sampled. If possible, measurements of temperature, pH and conductivity will be made at the sampling point; otherwise, samples will be placed in a transfer bottle and measurements will be made as follows:

- o The transfer bottle will be rinsed with sample water prior to filling.
- o Probes will be immediately submerged in the transfer bottle and measurements will be taken accordingly.
- o All field measurements will be recorded in a field notebook along with the sample location and the time and date of measurement.
- o After parameters are obtained, the transfer bottle and the probe(s) will be decontaminated by washing with laboratory detergent, cleaning with methanol and hexane, followed by a final rinse with de-ionized water. If the transfer bottle cannot be cleaned, a new bottle will be used.

7.0 SAMPLE CONTROL, DOCUMENTATION, AND SHIPPING

Samples will be handled in accordance with the general programmatic procedures established in Sections L and M of the REM II Quality Assurance Program Plan. Section L covered the requirements for handling, storage and shipping of samples; Section M, chain-of-custody.

The standard operating procedures for sample type delineation, handling, shipping, chain-of-custody, and related matters are presented in this section. The purpose of these procedures is to maintain the integrity (i.e., quality) of all samples during collection, transportation, analysis, and reporting. Procedures stated herein are necessary to validate the history of sample data from collection through reporting by providing adequate documentation. Procedures described here are from standard EPA sample handling and Contract Laboratory Program protocols.

7.1 SAMPLE TYPE DELINEATION AND HANDLING

The specific procedures for sample handling and labeling are determined by (1) the type of sample collected (i.e., either environmental or hazardous), and (2) if hazardous, the degree of contamination. The degree of contamination or concentration of contamination is specified as low, medium, or high. Sample type delineation for the Ordot Landfill Site is described below. Methods for sample handling are described in CDM procedure 5622001 (Table 5-1).

The groundwater sample will be collected away from known contaminated areas of the landfill and can be treated as a low concentration environmental sample. However, should the sample produce a reading of 10 ppm or greater on the HNu or OVA (instrument probe placed in sample jar or above sample), the sample will be considered as a medium concentration hazardous sample.

7.2 CUSTODY PROCEDURES AND DOCUMENTATION

Sample identification documents must be carefully prepared so that identification and chain-of-custody can be maintained, and sample disposition can be controlled. The sample identification documents utilized by EPA contractors are:

- o Inorganic and Organic Traffic Reports, including sample identification numbers
- o Region IX Sample Data Sheet
- o Chain-of-custody records
- o Custody seals
- o Field notebooks

These items are discussed below.

7.2.1 TRAFFIC REPORT FORM

The Traffic Report forms, described in Section 6.7.3 of the SAP, are the primary forms used for sample identification within the Contract Laboratory Program.

The pre-printed and pre-numbered adhesive sample labels affixed to the Traffic Reports must be secured to the sample containers by the sampler. Forms are filled out with waterproof ink. Where necessary, the label is protected from water and solvents with clear label protection tape.

Each Traffic Report will include the following information:

- o Sample Number
- o Project Code/Case Number
- o Sample Site Name/Code
- o Sampling Date
- o Sampling Personnel

- o Shipping Method and Date
- o Sample Description
- o Sample Matrix and Concentration
- o Sample Volume and Number of Containers
- o Sample Destination
- o Preservatives Used
- o Analyses Required
- o Special Handling Procedures
- o Container Lot Numbers

Upon returning from the field, sample numbers are recorded in the sample log book. Remaining Traffic Reports are distributed to appropriate organizations and personnel. Complete instructions for use of Traffic Reports are given in the User's Guide to the EPA Contract Laboratory Program.

7.2.2 CHAIN-OF-CUSTODY

To document sample possession, chain-of-custody procedures are followed. The procedures used by EPA contractors are outlined in the sections below. Alternative procedures are acceptable provided that proper custody of the samples is maintained and the procedures are approved by EPA personnel in advance.

Field Custody Procedures

- o Collect only enough samples to provide a good representation of the media being sampled. To the extent possible, the quantity and types of samples and sample locations are determined before the actual field work. As few people as possible should handle samples.
- o The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly.

- o The on-site Coordinator determines whether proper custody procedures were followed during the field work and decides if additional samples are required.

Transfer of Custody and Shipment

- o Samples are accompanied by a Chain-of-Custody Record (see Section 6.7.2 of the Sampling and Analysis Plan). When transferring samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer.
- o Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate Chain-of-Custody Record accompanying each shipment (one for each field laboratory). A chain-of-custody seal is placed on each sample container and placed in the shipping container. Shipping containers are padlocked or sealed with Custody Seals for shipment to the laboratory. The method of shipment, courier name(s), and other pertinent information are entered in the "Remarks" section of the Chain-of-Custody Record.
- o All shipments are accompanied by the Chain-of-Custody Record identifying its contents. The original record accompanies the shipment, and the pink copy to Region IX QAMS, a photocopy retained by sampler.
- o If sent by common carrier, a Bill of Lading is used. Air freight shipments are sent collect. Freight bills, Postal Service receipts, and Bills of Lading are retained as part of the permanent documentation.

Laboratory Custody Procedures

- o A designated sample custodian accepts custody of the shipped samples and verifies that the information on the Sample Identification number matches that on the Chain-of-Custody Records. Pertinent information as the shipment, pickup, and courier is entered in the "Remarks" section. The custodian then enters the Sample Identification number data into a bound log book, which is arranged by project code and station number.
- o The laboratory custodian uses the Sample Identification number or assigns a unique laboratory number to each sample and ensures that all samples are transferred to the proper analyst or stored in the appropriate secure area.

- o The custodian distributes samples to the appropriate analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian.
- o When sample analyses and necessary QA checks have been completed in the field laboratory, the unused portion of the sample must be disposed of properly. All identifying tags, data sheets, and laboratory records are retained as part of the permanent documentation. Sample containers and remaining sample material are disposed of appropriately.

7.2.3 CUSTODY SEALS

When samples are shipped to the EPA contract laboratory, they must be placed in padlocked containers or containers sealed with custody seals to ensure samples are not tampered with. Due to the potential for a customs search, seals will be placed on each sample container. In addition, two seals must be placed on each shipping container (cooler), one at the front and one at the back so as to allow the recipient of the container to make a determination as to whether or not the container has been opened. Clear tape should be placed over the seals to ensure that seals are not accidentally broken during shipment.

7.2.4 REGION IX SAMPLE DATA SHEET

As required by Region IX, a sample data sheet will be completed for each sample collected. This data sheet, which assists in tracking the sample and information regarding sample numbers, case numbers, media, containers, etc., is required. The specifics associated with completing the form are provided in the SAP, Section 6.7.3.

7.2.5 DISTRIBUTION OF COPIES

The distribution of quality control and sample identification documentation will be as follows:

1. Chain-of-Custody Record - original accompanies sample, pink copy to Region IX QAMS, and a photocopy to the sampler's files.
2. Inorganic and Organic Traffic Reports - originals to SMO, second copy (pink to Region IX QAMS), third and fourth copies accompany samples, and a photocopy is made for sampler's files.
3. Sample Data Sheet - send to Region IX QAMS.

QAMS' address is:

U.S. EPA Region IX
QAMS (P-3-2)
215 Fremont Street
San Francisco, CA 94105
Attn: Stewart Simpson

SMO's address is:

U.S. EPA
CLP Sample Management Office
P.O. Box 818
Alexandria, VA 22313

7.3 FIELD NOTEBOOKS

In addition to Sample Identification Numbers and Chain-of-Custody Records, a field notebook must be maintained by the field team leader to provide a daily record of significant events, observations, and measurements during field investigations. The field notebook will contain information such as: personnel present, site conditions, sampling procedures, measurement procedures, calibration records, etc.

The project notebook and will be distributed according to the procedures outlined in Section 11.0. The information contained in the notebook will be summarized and interpreted for use in the Phase I Report.

All entries in the field notebooks shall be signed and dated. The field notebooks shall be kept as a permanent record.

These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings.

7.4 CORRECTIONS TO DOCUMENTATION

As previously stated, all original data recorded in field notebooks, Chain-of-Custody Records, and other forms are written with waterproof ink. None of these documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on a document should be corrected by the person who made the entry. All subsequent corrections must be initialed and dated.

7.5 SAMPLE SHIPPING

Policies, procedures, and guidelines for shipping of environmental and hazardous samples are presented in CDM Procedure 5622001 (Table 5-1) and in the SAP.

Refer to Section 11.0 for additional information on document control.

8.0 EQUIPMENT CALIBRATION, MAINTENANCE, AND OPERATION

General programmatic requirements for the calibration of instruments are established in Sections E and K of the REM II Quality Assurance Program Plan. As an activity which affects data quality, instrument calibration must be done in accordance with the requirements of Section E for formal written procedures. Section K further requires that instruments be calibrated and maintained to operate within manufacturers' specifications by trained regional personnel.

A variety of instruments, equipment, and sampling tools will be used to collect data and samples and to monitor site conditions. Proper calibration, maintenance, and use of instruments and equipment are imperative to ensure quality of all data collected. A record of calibration and maintenance activities is as important as the data record itself in order to provide legally dependable data. The responsibility for proper equipment calibration and maintenance lies with the REM II equipment manager.

. 8.1 INSPECTION

All instruments and equipment purchased or used on the REM II program are inspected to ensure that the item meets and performs to project specifications. Instruments meeting requirements of the program are given a control number and made available for site use. Instruments and equipment not meeting program requirements are labeled "hold - not available for use" and are withheld from REM II field use. Such instruments and equipment are not available for use until they can be modified or repaired to meet REM II requirements.

8.2 WRITTEN OPERATING PROCEDURES

The calibration, maintenance, and operating procedures for all REM II instruments, equipment, and sampling tools must be documented in written procedures and incorporated into the REM II Site Investigation Procedures Manual prior to use on any site. These procedures are based on

manufacturer's instructions and common practice and include specifications and criteria for calibration, maintenance, and operation. The specific procedures that will be implemented during the Ordot Landfill site investigations are listed in Table 5-1.

8.3 CALIBRATION

Each piece of equipment used in activities affecting data quality is calibrated at a frequency specified by either the manufacturer's specifications or criteria or limitations established by the REM II program. Where manufacturer's specifications differ from the REM II program criteria, the more stringent calibration schedule will be used.

Written operating procedures have been developed and shall be used to calibrate equipment. These procedures are incorporated in the Site Investigation Procedures Manual and are listed in Table 5-1. They contain as a minimum:

- o Equipment identification
- o Control number
- o Calibration schedule and frequency
- o Equipment specifications
- o Specification verification (where applicable)
- o Equipment necessary to accomplish calibration
- o Procedure for calibration

Instruments and equipment requiring calibration have a calibration sticker affixed which identifies the following information:

- o Date of calibration
- o Next due date for calibration
- o Initials of person performing calibration
- o Any additional information (e.g., instrument settings) required for proper instrument use.

An equipment log sheet, as well as calibration work sheets (where applicable) is kept for each piece of equipment whose performance is affected by use. Equipment log sheets are bound into equipment logbooks and contain:

- o Date of calibration
- o All data pertaining to the calibration procedures
- o Next due date for calibration
- o Initials of analyst performing calibration
- o Adjustments made and the accuracy of the equipment prior to and following calibration
- o Record of equipment failure or inability to meet specifications

If the calibration schedule is not adequately maintained or accuracy as reported in the specification cannot be attained, that instrument is labeled "Hold" and is unavailable for use until repaired so that specifications are attained.

General calibration requirements are presented below.

- o All adjustable, mechanical, electronic, and/or recording instruments will be calibrated prior to entry into the field.
- o Measuring devices such as steel tapes will be calibrated twice each year to check for kinks, stretching, or worn markings.
- o Instruments that cannot be readily calibrated (e.g., sampling pumps) will be performance-checked versus a similar instrument with known performance. If the performance of the instrument varies by more than +5% it will be returned to the manufacturer for proper maintenance or repair.
- o Instruments that require frequent calibration checks or calibration during use (e.g., pH meters) will be calibrated as specified in their operating procedures.

8.4 MAINTENANCE

Each piece of equipment used in activities affecting data quality is maintained to specifications presented by the manufacturer. REM II Equipment Managers will be responsible for performing routine maintenance and will have available tools and spare parts to conduct routine maintenance. Maintenance items that cannot be performed by the Equipment Manager will be performed by a person certified or trained to repair the instrument.

Written operating procedures have been developed for maintaining instruments. These procedures will be followed to maintain instruments. Instruments will be calibrated to proper specifications following maintenance to ensure proper completion of the maintenance procedure.

The date of maintenance will be recorded on the instrument's calibration tag. A record of maintenance, including a description of specific activities performed, will be made in the equipment logbook. This book is kept in the equipment room with the instrument. Data recorded in the logbook are similar to the data recorded for calibration.

If the equipment or instrument cannot be maintained to manufacturer's specifications or cannot be properly calibrated, it will be returned to the manufacturer or other repair facility for proper maintenance and repair. Once received back from the manufacturer, the instrument is checked for compliance to project specifications before being returned to routine field use.

Maintenance procedures to be used for instruments and equipment on the Ordot Landfill site are presented in Table 5-1. The equipment maintenance schedule is presented in Table 8-1. Critical spare parts are listed in Table 8-2.

TABLE 8-1
EQUIPMENT MAINTENANCE SCHEDULE

Equipment	Maintenance
YSI Model 33 S-C-T Meter	<p>Low readings are indicative of a dirty probe. Clean by soaking in a solution of 10 parts distilled water and 1 part HCl.</p> <p>Batteries should be replaced when it is impossible to red line the instrument. Two "D" size alkaline batteries are needed.</p> <p>Calibrate temperature to a NBS traceable thermometer.</p>
Haake Buchler pH Stick	<p>Rinse probe with distilled water after every use.</p> <p>Make sure absorbent pad at bottom of sheath is kept saturated with pH > solution.</p>
HNU Model PI 101	Clean lamp windows if readings are erratic or low. Recharge batteries after each use. Recalibrate weekly.
Gastechtor Hydrocarbon Survey Meter	Recharge batteries after each use. Recalibrate weekly.
OVA Model 128	Recharge batteries after each use. Recharge hydrogen supply after each use. Recalibrate weekly.
MINIRAM	Recharge batteries after each use.

TABLE 8-2
LIST OF CRITICAL SPARE PARTS

Equipment	Part
Haake Buchler pH Stick	pH solutions.
YSI Model 33 S-C-T Meter	Two "D" size alkaline batteries.
HNU Model PI 101	Lamp cleaning compound. Spare gas. Battery charger.
Gastechtor Hydrocarbon Survey Meter	Spare gas. Battery charger.
OVA Model 128	Spare gas. Battery charger.
MINIRAM	Battery charger.

8.5 MASTER EQUIPMENT CONTROL RECORD

An inventory control system including all equipment and instrumentation used by the REM II is maintained by the equipment manager as the basis for maintenance and calibration control. The inventory control documentation includes for each item:

- o Description of item.
- o Manufacturer, model number, and serial number.
- o Identification Number.
- o Name, address, and telephone number of company which services item.
- o Type of service policy.
- o Timing and frequency of routine maintenance, servicing, and calibration.

9.0 ANALYTICAL PROCEDURES

General programmatic requirements for analytical procedures are established in Section E and N of the REM II Quality Assurance Program Plan. Section E establishes the need for formally documented procedures. Section N requires:

- o The use of Contract Laboratory Program (CLP) laboratories and analytical procedures for all enforcement, litigation, and evidentiary data.
- o The specification of analytical procedures in the project operations plan for all engineering data (screening field samples, pilot laboratory studies) and non-CLP generated data.

Analytical procedures for samples to be analyzed by CLP laboratories are specified in the CLP contract. Procedures for collection and handling of all samples are specified in the Sampling and Analysis Plan and are listed in Table 5-1.

Samples collected will be analyzed by a Contract Laboratory Program (CLP) laboratory through Routine Analytical Services (RAS) requests. A list of all analytical procedures to be followed by the CLP is presented in Table 9-1. A description of the requirements of the contract laboratory is presented below.

9.1 GENERAL LABORATORY REQUIREMENTS

The purpose of the EPA Contract Laboratory Program is to provide analytical data of consistent and known quality from which to determine the nature and extent of contamination, base assessments of risk, institute remedial actions, or initiate enforcement actions to identify and mitigate threats to public health and environment. Protocols and methodologies are designed by the EPA to provide data of known quality in strict accordance with quality assurance procedures and chain-of-custody and document control requirements. Information on the types of samples which are analyzed is presented in the User's Guide to the EPA Contract Laboratory Program.

TABLE 9-1

CONTRACT LABORATORY PROGRAM ANALYTICAL PROCEDURES

PARAMETER	MATRIX	METHOD	REFERENCE
RAS Volatile Organics	Water	IFB for Organics	WA85-J680
RAS Semi-Volatile Organics	Water	IFB for Organics	WA85-J680
RAS Pesticides/PCB's	Water	IFB for Organics	WA85-J680
RAS Inorganics	Water	IFB for Inorganics	WA85-J838
RAS Cyanide	Water	IFB for Inorganics	WA85-J838

In general, the laboratory will adhere to those recommendations as promulgated in 21 CFR Part 58, "Good Laboratory Practices", criteria described in "Methods for Chemical Analysis of Water and Wastes", 1979 (EPA-600/4-79-020), the requirements of the EPA Contract Laboratory Program, and those presented in 40 CFR 136, "Guidelines Establishing Test Procedures for Analysis of Pollutants under the Clean Water Act." The general practices required of a CLP laboratory are presented below.

1. Purity of Standards, Solvents and Reagents

All reagents will be of the standard laboratory quality obtainable. Where applicable, reference standards solutions will be traceable to National Bureau of Standards (NBS). Each new lot of reagent grade chemicals shall be tested for quality of performance. These shall be tested by injection into a gas chromatograph (GC) to determine the extent of interferences in the GC profile.

2. Glassware

For organic analyses, the only acceptable sample container is amber glassware with a teflon-lined cap. All glassware used in organic analyses requires special cleaning. Preparation of glassware and other sample containers will be done in accordance with CLP specifications. All samples containers will be requested from I-Chem.

3. Analytical Analyses

- a. Laboratory pure water is prepared by a special deionized water system augmented by individual filter cartridges and polishers located at each outlet point. The polishers include special particulate filters, organic resins, and inorganic resins.
- b. Specially deionized water which has been boiled and purged with nitrogen gas will be used for volatile/priority pollutant analyses. Water prepared in this manner should be free of contamination and must be free of interference peaks when injected into the gas chromatograph.
- c. Field Blank

All water samples submitted for volatile organic contaminants or priority analysis must be accompanied by a field blank. Field blanks are prepared in the field prior to shipment to the laboratory, using organic-free water. They are stored alongside the collected samples and shipped back to the laboratory for analysis. Field blanks are analyzed with the field samples and they indicate whether the sample bottles were exposed to contaminants during handling and transit or if

samples were cross-contaminated. The laboratory should not be told which sample is the field blank.

d. Method Blank/Reagent Blank

- 1) A Laboratory pure water blank is analyzed along with all water samples submitted for analyses. The method blank is processed through all procedures, materials, and labware used for sample preparation.
- 2) In cases of non-aqueous samples, reagent blanks serve as method blanks.

e. Calibration Standards

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards are used to generate a standard curve and thereby quantify the compound in the environmental sample. A minimum of three (3) calibration standards will be used in generating a standard curve for all analyses. Specific requirements are outlined in the EPA Contract Laboratory Program.

f. Check Standard

A check standard is prepared in the same manner as a calibration standard. The final concentration calculated from the known quantities is the true value of the standard. The important difference in a check standard is that it is not carried through the same process used for the environmental samples, but is injected directly onto the gas chromatographic column. A check standard result is used to validate an existing concentration calibration standard file or calibration curve.

The check standard can provide information on the accuracy of the total analytical method independent of various sample matrices. Specific requirements and procedures for calibration and check standards are outlined in the EPA Contract Laboratory Program.

g. Control

A control is a sample of known value used to validate the analytical procedure. Control samples are prepared by the unit supervisor or his delegate and used each time a determination is made. One control is used for every ten samples and the value obtained must fall within $\pm 10\%$ of the true value for validation.

h. Spike

A sample spike is prepared by adding a known amount of a pure compound to the environmental sample (before extraction for extractables), and the compound is the same or similar (as in isotopically labelled compounds) as that being assayed for in the environmental sample. These spikes simulate the background and interferences found in the actual samples and calculated percent recovery of the spike is taken as a measure of the accuracy of the total analytical method. When there is no change in volume due to the spike, it is calculated as follows:

$$P = \frac{100 (O-X)}{T}$$

P = Percent Recovery

O = Measured value of analyte

X = Measured value of analyte
concentration in the sample before
the spike is added

T = Value of spike

Tolerance limits for acceptable percent recovery are established in the EPA Contract Laboratory Program.

i. Internal Standard

Internal standards are prepared by adding a known amount of pure compound to the environmental sample, and the compound selected is not one expected to be found in the sample, but is similar in nature to the compound of interest. Internal standards are added to the environmental sample just prior to analysis. (Note: Internal standards and surrogate spikes are different compounds. The internal standard is for quantification purposes using the relative response factor, while surrogate spikes indicate the percent recovery and therefore the efficiency of the methodology.)

j. Matrix Spike/Duplicate

Aliquots are made in the laboratory of the same sample and each aliquot is treated exactly the same throughout the analytical method. Spikes are added at approximately 10 times the method detection limit. The percent difference between the values of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$PD = \frac{2 (D_1 - D_2)}{(D_1 + D_2)} \times 100$$

PD = Percent Difference

D₁ = First Sample Value

D₂ = Second Sample Value (duplicated)

The tolerance limit for percent differences between laboratory duplicates should not exceed 15 percent for validation.

k. Quality Control Check Samples

Inorganic and organic control check samples are available from EPA Cincinnati free of charge and shall be used each quarter as means of evaluating analytical techniques of the analyst.

9.2 DATA REQUIREMENTS

Compounds to be analyzed by the contract laboratory include the Routine Analytical Services (RAS) series for volatile and semi-volatile organics, pesticides, inorganic metals, and cyanide. Procedures for these analyses are specified by the EPA for the contract laboratory program.

9.3 LABORATORY PERFORMANCE

EPA Contract Laboratory performance is continually monitored through ongoing Quality Assurance evaluation conducted by the Environmental Monitoring and Systems Laboratory/Las Vegas (EMSL/LV). These evaluations consist of periodic reviews of analytical data and supporting documentation complemented by quarterly on-site laboratory inspections.

On-site laboratory evaluations ensure continuing laboratory adherence to analytical and QA/QC procedures and that overall performance meets the requirements of the EPA Contract Laboratory Program. EMSL/LV also supports the EPA Contract Laboratory Program by developing and/or approving all methods, standards and protocols used by contract laboratories.

9.4 ANALYTICAL DATA REVIEW

Data validation will be performed on the data received from the analytical laboratory to ensure that all of the contract Quality Control (QC) criteria have been met. Every component of the data package will be inspected. A series of QC forms will be supplied with the analytical data package and will be used as part of the EPA data review process.

10.0 DATA REDUCTION, VALIDATION AND REPORTING

10.1 DATA LOGGING AND ANALYSIS

Upon receipt of samples for analysis (as accompanied by a completed request for analysis form, Organics Traffic Report, or Inorganic Traffic Report, and chain-of-custody detailing requested analysis), the laboratory supervisor or his delegate will:

- o Verify all paperwork, chain-of-custody forms, and similar documentation.
- o Log in samples, assign unique log numbers, and attach the numbers to the sample container(s).
- o Open project file and enter data into the file.
- o Assign priority and hazard rating criteria.
- o Store samples in a refrigerated sample bank.

The samples will then be analyzed for requested constituents following specified EPA procedures. The CLP will report values for each sample and provide results of QC sample analysis.

10.2 DATA VALIDATION

Data reduction, validation, and reporting of the samples by CLP laboratories will be performed in accordance with the specifications of the CLP criteria. Following the analyses and data reduction by the CLP laboratory, the data will be sent to EPA Region IX personnel for data validation, and then the REM II contractor. This procedure for the analytical data is briefly described below.

10.2.1 ANALYTICAL DATA

The validation of the analytical data will be performed in accordance with the accuracy and precision criteria outlined in the EPA Contract Laboratory Program (CLP) for analysis of chemical data. These procedures specify the

documentation needed and the technical criteria required to validate the data. The criteria are described below (some definitions have already been presented in Section 4.0, and are repeated here for convenience).

- o Completeness of analytical data. This criterion is a measure of the amount of valid data obtained from the measurement system compared with the amount that was expected under normal conditions. This criterion is expressed as a percentage.
- o Correctness of analytical data. This criterion is simply a check on all mathematical calculations, data transposition, units of measure, and significant figures.
- o Accuracy. The degree of agreement of a measurement (or an average of measurements of the same parameter), X , with an accepted reference or true value, T . This is usually expressed as the difference between two values, $X-T$, or the difference as a percentage of the reference or true value, $100 (X-T)/T$, and sometimes expressed as a ratio, X/T . Accuracy is a measure of bias in a system.
- o Precision. This criterion measures the reproducibility of a measurement. Precision may also be reported relative to some measurement of dispersion such as standard deviation.
- o Representativeness. In a laboratory setting, this criterion is usually evaluated according to the data's credibility, based on the QC officer's past experience with similar samples.

Accuracy is defined by the Contract Laboratory Program as a percent recovery for a spiked sample for organic analyses. Both matrix spikes and surrogate spikes are used to evaluate the data for accuracy. Matrix spikes are actual samples spiked with a representative group of hazardous substances list compounds. One sample for each set of samples or for each twenty samples (whichever is the more frequent) is required to be split for matrix spike analysis.

Precision is defined by the EPA Contract Laboratory Program as the relative percent difference of matrix spike recoveries for two matrix spikes of the same sample (matrix spike and matrix spike duplicates recoveries).

Validation of all analytical data will be performed by EPA Region IX staff. Laboratories will be required to submit results which are supported by

sufficient back-up data and QA/QC results to enable the reviewer to conclusively determine the quality of the data. Validity of all data will be determined based on the criteria described above. Upon completion of the review, the reviewers will be responsible for developing a QA/QC report for each analytical data package. This report along with a field activities documentation report will be submitted to the EPA Regional Site Project Officer summarizing the results obtained for all samples collected. The Regional Site Project Officer will forward the results to the Site Manager. All data will be distributed, stored and maintained according to the procedures outlined in Section 11.0. Where test data have been reduced, the method of reduction will be described in the report.

10.2.2 FIELD MEASUREMENT DATA

Validation of data obtained from field measurements will be performed by the project hydrogeologist and the On-Site Coordinator. Validity of all data will be determined by checking calibration procedures utilized in the field, and by comparing the data to previous measurements obtained at the specific site. Large variations (greater than 10 percent) will be examined in association with changes in local groundwater or soil conditions and general trends. Variations in data which cannot be explained will be assigned a lower level of validity and will be used for limited purposes. The project hydrogeologist and the On-Site Coordinator will summarize the data obtained from field measurements and will include this information in the field activities documentation report which will be submitted to the Site Manager and Remedial Project Manager for review.

10.3 FINAL REPORTING AND REPORT ARCHIVAL

Upon successful completion of the data validation process, all data generated at the Ordot Landfill Site will be entered into REMTECH, the REM II technical data base. Data will be available for analysis by the site manager and authorized personnel using a site-specific access code. Data summaries and results will be submitted in final report form. This report will consist of all pertinent sample and project information; it will also make specific reference to analytical procedures.

Section: 10.0
Revision: 0
Date: 2/10/87
Page: 4 of 4

Copies of all analytical data and/or final reports are retained in the laboratory files and, at the discretion of the laboratory manager, data will be stored on computer disks for a minimum of one year.

After one year or whenever the data becomes inactive, the files will be transferred to archives in accordance with Standard Laboratory Procedure. Data may be retrieved from archives upon request.

11.0 DATA MANAGEMENT AND DOCUMENT CONTROL

11.1 INTRODUCTION

11.1.1 PURPOSE OF DATA MANAGEMENT

This section specifies the procedures to be followed in handling data and documents for the Ordot Landfill Site. These procedures will ensure that all data and documents can be located by project personnel at any time, all data and documents are physically accounted for, confidential data and documents are protected from unauthorized access, and project records are properly archived at the end of the study. These procedures will be collectively referred to as the Data Management Plan.

11.1.2 SCOPE OF DATA MANAGEMENT PLAN

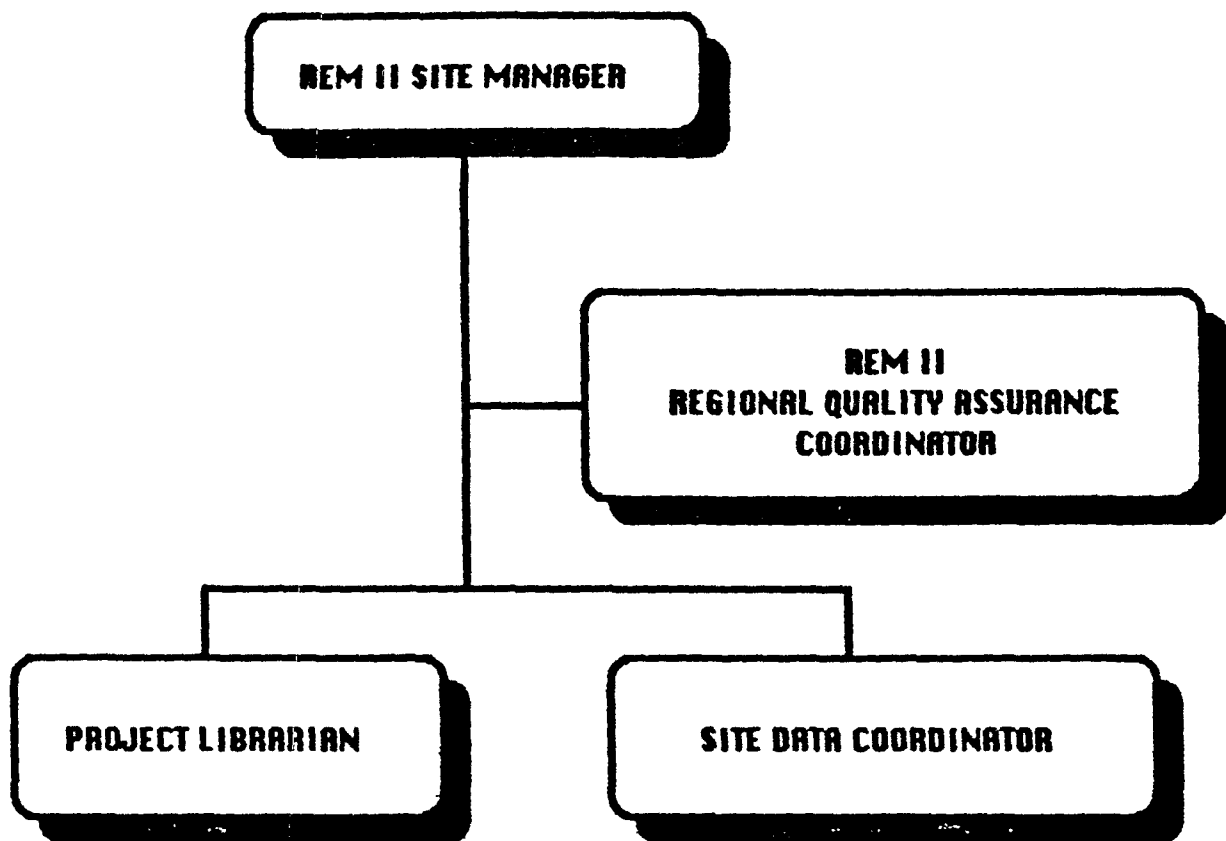
The Data Management Plan describes the data management personnel for the project and their responsibilities, the types of documents to be managed under this plan, and the procedures to be followed in managing them. The procedures include field procedures, document numbering and control, library filing and checkout, computer data base storage, and archiving of the data at the end of the project.

11.2 DATA MANAGEMENT PERSONNEL

11.2.1 DATA MANAGEMENT ORGANIZATION

The data management organization is shown in Figure 11-1. At the top of the organization is the REM II Site Manager. Reporting to him are the Field Data Coordinator and the Project Librarian. Since data management is closely related to Quality Assurance, the REM II Regional QA Coordinator is also shown as interfacing with the Data Management Organization.

The general responsibilities of each person are described below.



ORDOT LANDFILL, GUAM

DATA MANAGEMENT ORGANIZATION

CAMP DRESSER & MCKEE INC.

Fig.11-1

11.2.2 REM II SITE MANAGER

The REM II Site Manager has the responsibility for appointing the Field Data Coordinator and the Project Librarian and for ensuring that proper facilities are made available for them to carry out their responsibilities (e.g. adequate space for the project library). The site project manager has responsibility for the overall document control program and is responsible for the maintenance of the document control system. Project personnel are responsible for project documents that are removed from the Library or files while working on the RI.

11.2.3 FIELD DATA COORDINATOR

The Field Data Coordinator is responsible for ensuring that all data management procedures are correctly followed in the field. In general, he/she will be responsible for ensuring that all documents and samples have the appropriate identification numbers (described below under the headings "Document Control" and "Field Procedures") and are properly marked. This person will also keep a record of the custody of all documents and samples while they are in the field.

11.2.4 PROJECT LIBRARIAN

The Project Librarian is responsible for filing all project data, maintaining custody records for project data, ensuring that all project data that are submitted to the library are physically accounted for, and for assisting project personnel in data management procedures.

A computerized document control system has been established for the REM II contract (explained below in Section 11.3). The Project Librarian will use this system and will be the principal point of contact with the document control system for other project personnel. The Project Librarian will obtain needed document numbers, advise personnel on effective use of the system, and ensure that all procedures required by the system are implemented.

11.3 DOCUMENT CONTROL PROCEDURES

11.3.1 INTRODUCTION

In order to keep track of the documents to be produced by REM II, a project document control system has been developed. The purpose of document control is to assure that all documents have an identifying number assigned in a consistent way and to ensure that a central record of all project documents is maintained.

The document control system and general instructions for its use are presented in the REM II Management Plan and are not repeated here.

In general, the author of a document is responsible for requesting a document number. However, the Project Librarian will be available to assist and will usually obtain the document number at the request of the author. In the case of field documents (e.g. field logs), the Field Data Coordinator will request or obtain the necessary document numbers.

11.3.2 DOCUMENT TYPES AND IDENTIFYING CODES

Each work product (correspondence, log books, calculations, telephone reports, etc.) connected with REM II is an accountable document and will be assigned a document number. Part of that number is a code identifying the type of the document. Codes for some of the anticipated document types have been established. They are:

AL ANALYTICAL LOG BOOKS
CN CALCULATIONS/NOTES
CC CHAIN-OF-CUSTODY REC
CL CHECK-OUT LOGS
CA CONFIDENTIALITY AGMT
DM CONFLICT DISCLOSURE
CD CORP. CONFLICT DEC.
DD DOCUMENT OF DECISION
EC EPA CONTRACTS

ME MEDICAL RECORDS
MT MEET./TELE. REPORTS
PS PLANS AND SPECS
PO PRICE QUOTATION
PL PROJECT LOG BOOKS
QA QUALITY ASSURANCE
QC QUALITY CONTROL
RT REPORTS
RP REQ. FOR PROPOSALS

EP EPA CORRESPONDENCE
EN EQUIP. INVENTORY
FD FIELD DATA RECORDS
FI FINANCIAL STATEMENTS
FC FUTURE CONTR. DETER.
IN INDUSTRY CORRES.
CM INT. STA. OF CONFLICT
IO INTRA-OFFICE CORRES
IV INVOICES
LI LITIGATION DOCS.
SK LOE SUBCONTRACTS

SI SAMPLE ID DOCUMENTS
SN SAMPLE INVENTORY
ST STATE CORRESPONDENCE
PK SUB-POOL CONTR.
SP SUB-POOL CORRES.
SC SUBCONTRACTOR COR.
RE TEAM RESUMES
TP TECH/COST PROPOSALS
WA WORK ASSIGNMENTS
WP WORK PLANS
WM WORK PLAN MEMORANDA

11.4 FIELD DATA MANAGEMENT AND SAMPLE CONTROL

11.4.1 GENERAL PROCEDURES

Proper document and sample control is crucial to enforcement actions because the EPA's case in a formal hearing or criminal prosecution often hinges on evidence gathered by others. Therefore, detailed field records of inspections and investigations must be kept. All information pertinent to field activities must be recorded in the appropriate forms, field logbooks, sample tags, traffic reports, and sample chain-of-custody documents. All of these documents will be numbered. The Field Data Coordinator will keep a record of all the field documents relevant to a particular investigation, note who has custody of them at all times, and ensure that they are properly filed in the Project Library at the end of the investigation. The sections below detail the specific procedures for each type of document.

11.4.2 FIELD LOGBOOKS

All field measurements, observations, and other information pertinent to a field activity will be recorded in field logbooks.

A document number will be obtained for each logbook by the Field Data Coordinator before the logbook is used. The document numbers will be

recorded by the Field Data Coordinator. The logbook will be filed in the project library as soon as a document number is obtained (i.e., before any data is entered into it). It will then be checked out by the Field Data Coordinator for use in the field. Whenever custody of a logbook changes, the Field Data Coordinator will record the change of custody in the appropriate logbook.

The logbooks will be bound books with consecutively numbered pages. All pages in the logbooks will be accounted for. No pages are to be removed.

Entries in the logbooks are to be made in waterproof ink. Entries will be made legibly, and signed and dated. Each entry should include the sample location, field measurements taken, station number, and sample identification number. All in-situ measurements and field observations are recorded with all pertinent information necessary to explain and reconstruct field activities. Any changes to entries are to be made in a way that does not obscure the original entry. The reason for the change is to be noted and the change is to be signed and dated at the time it is made.

The Site Manager and the On-site Coordinator are responsible for ensuring that field notebooks and data forms are used during all monitoring activities and are stored safely. Any lost, damaged or voided field notebooks or data forms are reported to the Site Manager. Photographs that show field activities and monitoring locations are numbered to correspond to field notebook or data form entries. The names of the photographer and witness, date, time, site location, and site description are entered sequentially in the notebook. If a recognizable or standard scale is not included in the photograph, the field of view and distance to the subject is also noted. Once developed, the prints are labelled and stored correctly.

11.4.3 SAMPLE CONTROL

The Field Data Coordinator will ensure that all samples are properly tagged and recorded, and that the proper chain of custody procedures are followed at the site.

If a sample identification number is lost in shipment, or was never prepared for a sample(s), or a properly labeled sample was transferred without a formal Chain-of-Custody Record, a written statement is prepared detailing how the sample was collected, air-dispatched, or hand-transferred to the laboratory. The statement will include all pertinent information, such as entries in field notebooks regarding the sample and whether the sample was in the sample collector's physical possession or in a locked compartment until hand-transferred to the laboratory. Copies of the statement are distributed to the site manager.

Chain-of-custody procedures have been established for the Ordot Landfill Site and are described in Section 7.2 of this QAPP. These procedures must be followed whenever samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment it is collected, through analysis, and through introduction as evidence (if required).

Each time a sample changes custody, the appropriate notation must be made in the chain-of-custody documents.

Before the release of a final analytical report, each laboratory assembles documents and cross-checks information on corresponding sample identification numbers, Chain-of-Custody records, bench sheets, laboratory logbooks, and other logbooks to ensure that data pertaining to each particular sample are complete and consistent throughout the record. The field data coordinator then cross-checks field documents to ensure the information recorded corresponds with that of the laboratories and is consistent throughout the project record.

11.5 PROJECT LIBRARY PROCEDURES

11.5.1 GENERAL LIBRARY PROCEDURES

The Project Librarian will be responsible for administering the project

library. Documents to be filed include notebooks, log books, test analyses, calculation briefs, maps, diagrams, photographs, support reports, references, lab reports, and project reports. All project documents are to be filed in the library as soon as they are completed. By immediately filing all documents, it will be possible to maintain physical control over their location, to ensure that they are available for use by all members of the project team, and to make certain that they will be available at the end of the project for any future site actions.

Each document filed in the library will have an assigned document number. It is the responsibility of the originator of the document to ensure that a document number has been obtained, although the Project Librarian will assist in obtaining document numbers. Once a document number has been obtained, the document will pass into the custody of the Project Librarian for filing.

The Project Librarian will establish a system for checking out documents. The procedures will record the document number(s), the name and signature of the person checking out the document, the date, and the time the document is checked out. No documents are to be removed from the library without established checkout procedures. All documents will be checked back into the library upon their return.

11.5.2 FILING PROCEDURES AND CONFIDENTIAL FILES

Separate files will be maintained for the Ordot Landfill Site. They will be separated by document type, with the most current document on the top of the file.

All confidential files are to be marked as confidential and filed in a separate file. The REM II Site Manager will determine who is to be allowed access to confidential files. The Project Librarian will establish procedures for ensuring that only those authorized personnel have access. Confidential documents can be removed from the Project Library by authorized personnel only after the Project Librarian informs the person removing the documents that 1) they are confidential, 2) they are to be

stored in a locked file when not in use, and 3) only authorized personnel are to have access to them. It is then the responsibility of the person removing the documents to ensure that only authorized personnel have access to them.

11.5.3 CONFIRMATION THAT DOCUMENTS ARE FILED IN THE LIBRARY

Document control numbers will be obtained by the author of a document before it is filed in the Regional Project Library. Between the time that the document control number is obtained and the time that the document is actually filed, it must be properly accounted for.

The document control system has a status function that indicates if the document has been filed in the library. When the document is filed in the Regional Project Library, the librarian will change the filed status from 'N' to 'Y' to confirm that the document has been filed in the library.

If the librarian has changed the "filed" status to 'Y', it will be indicated on the index; thus confirmation is complete. If the 'filed' status indicated 'N', then the document will be located and accounted for.

Periodically, the REM II Regional Project Librarian will cross-check for missing documents. Additionally, periodic physical inspection of Regional files will take place to ensure compliance with stated criteria.

11.5.4 EPA ENFORCEMENT CLASSIFICATIONS AND HANDLING PROCEDURES

Documents that are classified by EPA as enforcement materials will be handled according to procedures described below. EPA divides enforcement materials into three classifications:

- o General Enforcement
- o Enforcement Confidential
- o Enforcement Sensitive

"Enforcement Sensitive" are all materials that contain information directly related to the government's case. These materials include names of informants, identification of witnesses and their testimony, settlement positions, discussions or analyses of potential weaknesses in the government's case, and other similar information.

"Enforcement Confidential" are all materials that have not been reviewed or checked for accuracy, and thus should not be generally distributed or otherwise made public. These materials include draft documents, results of analyses that have not been verified, internal memoranda, and other similar documents.

"General Enforcement" materials are all other materials that are accumulated during the development of an enforcement case. These include materials that document statutory or regulatory violations.

All enforcement files are secured in locked file cabinets or equally secure areas during other than normal working hours, unless files are personally attended by a person authorized to have access to such files.

A continuous and permanent record is maintained of all persons who access enforcement files, including for each file: person having access, data and period of access, and location of file.

Any employee who is not a member of the project staff or management is not allowed immediate or direct access to enforcement files without approval of the responsible site manager or other designated management staff.

11.6 COMPUTER DATA STORAGE

11.6.1 USE OF COMPUTER DATA BASES

Computer data bases will be used during the project for both archiving and analysis of data. A central data base, System 1032 (described below), has been established by the REM II National Program Management Office (NPMO) to store all data collected by all projects. Data can be copied from this

data base to local data bases or files for further analysis or modeling. Local data bases include various microcomputer software systems with searching, reporting, mapping and graphics capabilities.

11.6.2 CENTRAL DATA BASE

All data will be stored on computer files using the "System 1032" software package. System 1032 is a standard and widely used relational database marketed by Software House in Cambridge, Massachusetts. The package has been designed for storing all the analytical data from REM II applications. This design includes file structure and validity checks. The System 1032 central data base is installed on the Digital Equipment Corporation VAX 11-750 computer in Annandale.

All REM II project data will be entered into System 1032. After it has been entered, it can then be retrieved and used for analyses. Under no circumstances will data be used for analysis unless it has been entered in the System 1032 and retrieved. There are two reasons for this. First, the software includes validation procedures to check all entries. It will flag entries which fall outside of reasonable bounds as possible errors. Entries such as site codes, social security numbers of project personnel, chemical names, and sampling methods will be verified against master lists within the data base. Actual data entry will be verified using standard quality control procedures. Unless data is entered in System 1032 before its use in an analysis, the results of the analysis will be questioned. Second, the act of entering all data in System 1032 before its use will ensure that all data has been sent to the NPMO for preservation.

The software will produce output files that can be used with other application programs on the VAX (models written in FORTRAN, for example). The output files can also be transferred to other computers and microcomputers so that they can be used with other approved models.

11.6.3 LOCAL DATA BASES

Two computer systems will be available for use on the project: a Digital

Equipment Corp. Rainbow microcomputer and an IBM XT microcomputer. Data files can be stored and manipulated on these computers. Files can also be transferred between these computers.

Data will be stored and manipulated on the IBM using the dBase III data base system. This is a relational data base system with extensive searching and reporting capabilities. Mapping and graphics capabilities are available on the IBM or Rainbow through Lotus 1-2-3 or Surface II software.

All data files will be verified by standard QC checks on data entry and by processing through the central data base.

11.6.4 DATA BACKUP

The IBM computer hard disk files are backed up every week on floppy disks. These disks are preserved for 25 weeks. If a particular analysis requires more frequent or longer term backup, it is the responsibility of the analyst to arrange for it.

Data stored on the Rainbow will be stored in floppy disk. The primary disk will be copied frequently and stored in a separate place to provide backup for the Rainbow data files.

11.7 DATA ARCHIVING

All project data will be archived at the end of the project to ensure that they are physically preserved and to ensure that they are available to support future actions at the site.

All computer files held at CDM will be printed out in hard copy form and transferred to magnetic tape or disk. The hard copies, tapes, and disks will be placed in the library and indexed along with the other documents. It will be the responsibility of NPMO to archive all project files maintained on the VAX. It is anticipated that the entire library will then be transferred to the custody of the NPMO for preservation.

12.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

General programmatic requirements for internal quality control (QC) checks are established in Sections E, I and P of the REM II Quality Assurance Program Plan.

12.1 QUALITY CONTROL CHECKS FOR LABORATORY ACTIVITIES (CLP)

Internal quality control procedures are designed to assure the consistency and continuity of data. If required, external QC procedures (interlaboratory checks) are carried out to assess the accuracy of the data generated. Internal QC procedures are as follows:

- o Instrument performance checks
- o Instrument calibration
- o Documentation on the traceability of instrument standards, samples, and data
- o Documentation on analytical methodology and QC methodology. QC methodology includes spiked samples, duplicate samples, and split sample use of reference blanks and check standards for method accuracy and precision.
- o Documentation on sample preservation and transport

Quality control of the sample data will involve collection of field sample duplicates and blanks and evaluation of the laboratory data. In addition to the procedures for sample collecting and handling described in this plan, it is anticipated that EPA's standard quality control procedures for the Contract Laboratory Program will be used.

Quality Control of field data obtained from measurement equipment will be accomplished by following the guidelines specified in the Sampling and Analysis Plan, and by performing proper calibration procedures at the frequencies specified. In addition, the quality control samples discussed below shall be collected.

Samples collected for analysis by the Contract Laboratory Program will be accompanied by the following quality control samples:

- o One duplicate sample for all analytical parameters being sampled will be collected per matrix per laboratory per site per day, or one for every 10 samples, whichever is more frequent. The duplicate sample will not be labeled as such. Duplicates will be collected from areas of known or suspected contamination.
- o One triplicate sample will be collected for every 20 aqueous samples destined for organics analysis.
- o One volatile organic travel blank will be included for each day of sampling for volatile organic analysis.

Rinsate or equipment blanks will not be collected since equipment to be utilized for the sample collection will be disposed of following use. Laboratory performance standards for the CLP will be in compliance with the specifications of the CLP Statement of Work (EPA, 1984b; EPA, 1985).

12.2 QUALITY CONTROL PROCEDURES FOR FIELD MEASUREMENTS

All field measurements and sampling will be performed as specified in the SIPMs, unless otherwise indicated. A performance audit may occur during sampling to verify compliance with sampling SOPs.

12.2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be obtained by utilizing either an electric well sounder or a graduated steel tape. Prior to obtaining measurement data, field personnel should check to see that the instrument has been properly calibrated (see Section 6.0 and 8.0).

At each location and/or time interval, a minimum of two measurements should be taken. Both readings will be recorded in the field notebook or on the appropriate field data form. Data should be recorded to the nearest 0.1 ft.

In addition to replicate measurements, the data should be compared to previous measurements obtained at the well site. If large discrepancies exist from the previous measurements which cannot be explained by local groundwater activities, changes, or trends, the equipment should be recalibrated and the measurements repeated. If possible, an alternative instrument should be utilized to verify the accuracy of the data.

12.2.2 WATER QUALITY PARAMETERS

Measurements of temperature, pH, and electrical conductance will be performed during the well water sampling event. Prior to obtaining measurement data, field personnel should check to see that the instrument is properly calibrated (see Sections 6.0 and 8.0). For pH and electrical conductance, reference solutions can be prepared and should be utilized to properly calibrate the instrument.

When obtaining data for water quality parameters, measurements should be compared with previous data and examined for large variations. If variations greater than 10% exist and cannot be accounted for by changes in field conditions and/or water quality stabilization, the instrument should be recalibrated and the measurements repeated. The most accurate measurement will be determined by the on-site hydrogeologist and recorded in the field notebooks or on the appropriate field data form. If possible, an alternative measuring device (i.e., another thermometer, pH meter, or electrical conductance meter) should be utilized to verify the data.

12.2.3 AIR QUALITY PARAMETERS

Measurements of organic vapors, methane gas, and explosive atmospheres will be made in the field using portable instruments. These instruments will be

checked for calibration and maintenance labels prior to use. The HNu and OVA instruments must have been calibrated at least one week prior to use. The HNu is calibrated against known isobutylene concentrations and the OVA against known methane concentrations. Also prior to use, the battery level, hydrogen level in the OVA, and instrument response to a wide tip marker pen must be checked. The explosivity meter must have a sticker showing calibration and response factors performed within one week of use.

12.3 QUALITY CONTROL CHECKS FOR DELIVERABLES

Quality control checks (reviews) of all deliverables will be performed by the REM II team and the EPA. Certain documents will also be reviewed by EPA Region IX, Guam EPA, and the potentially responsible parties' technical review committee. A schedule of deliverables and reviews is included as Figure 2-5.

A preliminary list of deliverable items and reviews is included as Table 2-1.

13.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed in accordance with the procedures established in Section 0 of the REM II Quality Assurance Program Plan and summarized in its Audit Flow chart reproduced as Figure 13-1. All audits must be initiated by the REM II Quality Assurance Director (QAD) or her Deputy, or by the CDM Corporate Quality Assurance Manager. The REM II QA Coordinator for Region IX, Neil E. Botts, and auditors appointed by the QAD (Rosemary Ellersick), or her Deputy, will be responsible for implementing the audits.

13.1 SYSTEMS AUDITS

Systems audits have been scheduled during the WP and RI Phases. Systems audits will be carried out to verify that:

- o The necessary procedures of the Work Plan and Remedial Investigation phases are established.
- o The reviews and sign-offs required in Section 3 of the Technical Operations Manual are being implemented.

13.2 PERFORMANCE AUDITS

The QAD, or his Deputy, will determine the need for a performance audit(s), taking into consideration the recommendations of the REM II Regional QA Coordinator and the status of the Ordot Landfill site as an enforcement lead site.

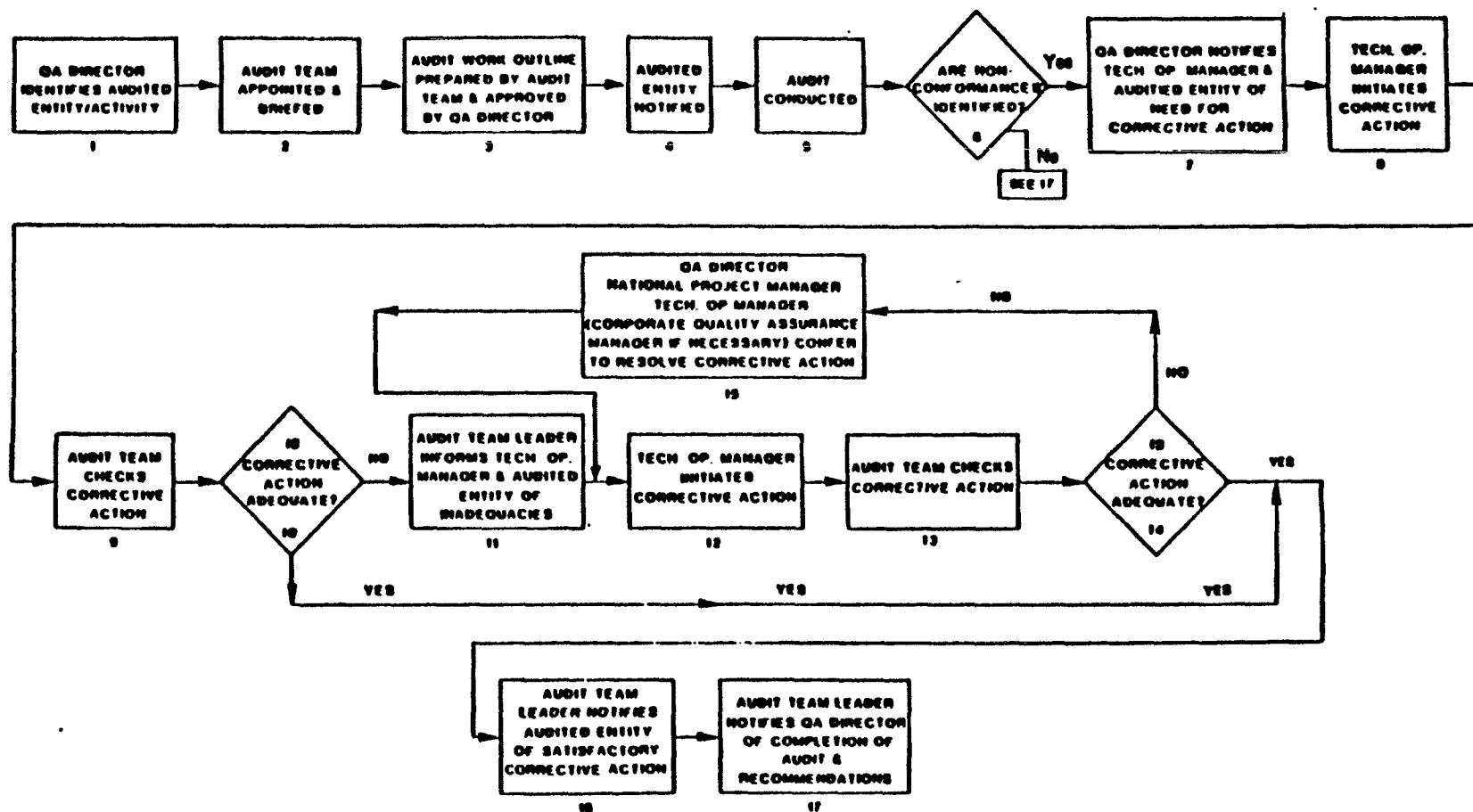


Figure 13-1 Audit Flow Chart

14.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

The assessment of data measurements is an activity that affects data quality. In accordance with Section E of the REM II Quality Assurance Program Plan, formally documented procedures must therefore be established for data measurement assessment.

Field data collected during the monitoring efforts will be analyzed through the EPA Contract Laboratory Program (CLP). Table 14-1 provides a summary of the number and types of water samples to be sent through the CLP.

The EPA Contract Laboratory Program provides analytical data of consistent and known quality from which to determine the nature and extent of contamination, base assessments of risk, institute remedial actions, or initiate enforcement actions to identify and mitigate threats to public health and environment. Protocols and methodologies are designed by the EPA to provide data of known quality in strict accordance with quality assurance procedures and chain-of-custody and document control requirements. Information on the types of samples which are analyzed may be found in the User's Guide to the EPA Contract Laboratory Program.

In general, the laboratory will adhere to those recommendations as promulgated in 21 CFR Part 58, "Good Laboratory Practices", criteria described in "Methods for Chemical Analysis of Water and Wastes", 1979 (EPA-600/4-79-020), the requirements of the EPA Contract Laboratory Program, and those presented in 40 CFR 136", Guidelines Establishing Test Procedures for Analysis of Pollutants under the Clean Water Act."

14.1 ACCURACY

A sample spike is prepared by adding a known amount of a pure compound to the environmental sample (before extraction for extractables), and the compound is the same or similar (as in isotopically labelled compounds) as that being assayed for in the environmental sample. These spikes simulate the background and interferences found in the actual samples and calculated percent recovery of the spike is taken as a measure of the accuracy of the

TABLE 14-1

SUMMARY OF WATER SAMPLE DATA COLLECTION

Sample Type	Location													
	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	GW-1	Other
Surface Water	1	1	0	0	0	0	0	0	0	0	0	0	0	1 - duplicate
Leachate Stream	0	0	1	1	1	1	1	1	1	1	0	0	0	1 - duplicate
Leachate Pond	0	0	0	0	0	0	0	0	0	0	0	1	0	—
Ground Water	0	0	0	0	0	0	0	0	0	0	0	0	1	1) Well at Washington Jr. High School 2) 1 - duplicate
Spring Water	0	0	0	0	0	0	0	0	0	0	1	0	0	—
Travel Blanks	Three, one for each day of anticipated sample shipment.													
Total	19													

total analytical method. When there is no change in volume due to the spike, it is calculated as follows:

$$P = \frac{100 (O-X)}{T}$$

P = Percent Recovery

O = Measured value of analyte

X = Measured value of analyte
concentration in the sample before
the spike is added

T = Value of spike

Tolerance limits for acceptable percent recovery are established in the EPA Contract Laboratory Program.

14.2 PRECISION

Aliquots are made in the laboratory of the same sample and each aliquot is treated exactly the same throughout the analytical method. Spikes are added at approximately 10 times the method detection limit. The percent difference between the values of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$PD = \frac{2 (D_1 - D_2)}{(D_1 + D_2)} \times 100$$

PD = Percent Difference

D₁ = First Sample Value

D₂ = Second Sample Value (duplicated)

The tolerance limit for percent differences between laboratory duplicates should not exceed 15 percent.

14.3 COMPLETENESS

Completeness will be measured as:

$$C = \frac{V}{T} \times 100\%$$

C = Completeness of analytical effort, in percent

V = Number of sample analyses that have been validated

T = Total number of samples that have been submitted for validation

The targets for completeness for specific parameters are presented in Table 4-1 and range from 85 to 90%.

14.4 COMPARABILITY

Comparability of data is ensured through the use of standard analytical methods or methods with demonstrable equivalency in terms of method performance criteria and equivalent reported units.

15.0 CORRECTIVE ACTION

All nonconformances with the established quality control procedures will be identified and controlled in accordance with Section P of the REM II Quality Assurance Program Plan. No additional work which is dependent on the nonconforming activity will be performed until the nonconformance is corrected.

Corrective actions will be implemented and documented in accordance with Section Q of the REM II Quality Assurance Program Plan. Corrective actions will be defined by the Technical Operations Manager and implemented to the satisfaction of the Quality Assurance Director. A summary of the procedure for correcting nonconformances is depicted in Figure 13-1, Audit Flow Chart.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Quality Assurance Director or her designee will review all aspects of the implementation of this Quality Assurance Project Plan on a monthly basis and submit a summary report to the Chairman of the Board and the Executive Vice President of CDM in accordance with Section B.8 of the REM II Quality Assurance Program Plan. These reviews will include an assessment of data quality, and the results of systems and/or performance audits as appropriate.

In the event of a disagreement between the Quality Assurance Director and the Technical Operations Manager on the adequacy of corrective actions implemented by the latter, the CDM Corporate Quality Assurance Manager may be informed and requested to confer on a resolution of the dispute in accordance with Section O of the Quality Assurance Program Plan (see Figure 13-1).

REFERENCES

- CDM Team. October 1984. REM II Quality Assurance Program Plan. Performance of Remedial Response Activities at Uncontrolled Hazardous Waste Sites. Document No. 999-QC1-RT-ACAB-3.
- CDM Team. December 1984. REM II Site Investigation Procedures (Draft). Performance of Remedial Response Activities at Uncontrolled Hazardous Waste Sites.
- CDM Team. April 1985a. REM II Technical Operations Manual. Performance of Remedial Activities at Uncontrolled Hazardous Waste Sites. Document No. 999-TS1-RT-ASSK-3.
- CDM Team. December 1985. Work Plan. Ordot Landfill Site, Guam. Limited Remedial Investigation. Document No. 279-WP1-WP-CBJT-1.
- CDM Team. December 1986. Draft Sampling and Analysis Plan for Initial Site Characterization Management Plan. Ordot Landfill Site, Guam. Initial Site Characterization. Document No. 279-WP1-PS-CCYE-1.
- USATHAMA. March 1983. Analytical Methods, Descriptions.
- USEPA. March 1979. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-02.
- USEPA. March 1979. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019.
- USEPA. February 1983. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, EPA-600/4-83-004.
- USEPA. 1983. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.
- USEPA. July 1984a. User's Guide to the Contract Laboratory Program.
- USEPA. July 1984b. Statement of Work, Inorganic Analysis, Contract Laboratory Program. SOW No. 784.
- USEPA. January 1985. Statement of Work for Organics Analysis, USEPA Contract Laboratory Program. IFB WA 85-J176-J178.

Appendix A

APPENDIX A

SITE INVESTIGATION PROCEDURES

The following procedures, which were taken from CDM's "Site Investigation Procedures Manual," are provided in this Appendix.

<u>Procedure Title</u>	<u>Procedure Number</u>
Operation Procedure for HNu Model PI-101 Photo-ionization Analyzer	5607001
Operating Procedure, Century Portable Organic Vapor Analyzer (OVA), Model 128	5607003
Operation Procedure for Gastechtor Hydrocarbon Surveyor, Model 1314	5607004
Procedure for Operation of the GCA Miniram Particulate Aerosol Monitor Model PDM-3	5607021
Procedure for Determination of Dissolved Oxygen, YSI Model 57 Dissolved Oxygen Meter	5617001
Operation Procedure YSI Model 33 S-C-T Meter (Salinity, Conductivity, Temperature)	5617002
Operation Procedure for Haakebuchler pH Stick	5617003
Procedure for Determining Temperature of Groundwater	5617004
Procedure for Filtration of Samples	5617007
Procedure for Water Level Measurement	5619007
Procedure for Well Evacuation	5619008

APPENDIX A, continued

<u>Procedure Title</u>	<u>Procedure Number</u>
Considerations for Sample Withdrawal from Wells	5619009
Surface Water Sampling Guidelines	5620001
Procedure for Use and Maintenance of Field Notebooks	5621004
Sample Classification, Handling & Shipment	5622001
Sample Identification Procedure	5622002
Chain of Custody	5622005
Sample Bottle Preparation, Sample Preservation and Maximum Hold Times	5622006
Samples Collected for Quality Control Purposes	5622007
Equipment and Instrument Calibration and Maintenance, General Requirements	6600001
Calibration Procedures for the HNu PI-101	6607001
Calibration and Maintenance Procedure Century Systems Portable Organic Vapor Analyzer Model OVA-128	6607003
Calibration and Maintenance Procedure YSI Model 33 S-C-T Meter	6617002
Calibration and Maintenance Procedures Haakebuchler pH Stick	6617003
Calibration and Maintenance Procedures for Gastechtor Hydrocarbon Surveyor, Model 1314	6607604
Calibration and Maintenance Procedures for GCA MINIRAM Particulate/Aerosol Monitor PDM-3	6607021
Calibration and Maintenance Procedure for YSI Model 57 Dissolved Oxygen Meter	6617001

OPERATION PROCEDURE FOR
HNU MODEL PI 101
PHOTOIONIZATION ANALYZER

1.0 INTRODUCTION

1.1 Operation Principle

The HNU Model 101 photoionization detector has been designed to measure the concentration of trace gases in many industrial or plant atmospheres. The instrument has similar capabilities outdoors. The analyzer employs the principle of photoionization for detection. This process is termed photoionization because the absorption of ultraviolet light (a photon) by a molecule leads to ionization via:



where RH = trace gas

$h\nu$ = a photon with an energy greater than or equal to an ionization potential of RH.

The sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics), but do not ionize the major components of air such as O_2 , N_2 , CO, CO_2 or H_2O . A chamber adjacent to the ultraviolet light source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions, formed by absorption of UV light, to the collector electrode where the current (proportional to concentration) is measured. The useful range of the instrument is from a fraction of a ppm to about 2,000 ppm.

1.2 Instrument Sensitivity and Calibration

The instrument responds to atmospheric compounds with ionization potentials equal to or less than the ionization energy of the UV light source. If a compound in air has an ionization potential greater than the energy source of the lamp, it will not be detected. Table 1 presents organic and inorganic compounds and the light sources that should be used to detect each compound. The instrument is capable of using 1 of 3 light sources - 9.5, 10.2, and 11.7 eV lamps. In addition, not all compounds respond equally to each light source and thus they vary in their sensitivity to ionization. As a result of varying sensitivities to photoionization, the response given by the instrument may or may not reflect the actual atmospheric concentration of the compound being detected. Reporting of instrument reading should thus be in terms relative to the calibration gas used, not in terms of actual atmospheric concentrations. Table 2 presents the relative sensitivities for various gases relative to a 10.2 eV light source. Use this table to determine the approximate response of the instrument to a compound of interest. The instrument can be calibrated to respond directly in ppm/volume by adjusting the response potentiometer to a known calibration gas for that compound. To do this, complete Procedure 6607001 and replace the isobutylene span gases with the compound of interest.

2.0 INSTRUMENT SPECIFICATIONS

Performance

- o Range: 0.1 to 2,000 ppm
- o Detection limit: 0.1 ppm
- o Sensitivity (max) 0 to 2 ppm FSD over 100 division meter scale

Procedure: 5607001
Revision: 0
Date: 3/85
Page: 3 of 12

TABLE 1 LAMP SOURCE IONIZATION POTENTIALS
FOR ORGANIC AND INORGANIC AIRBORNE COMPOUNDS

9.5 eV Lamp Source	
Acids (organic)	Dimethyldisulfide
Alcohols	Dimethylsulfide
Amines	Ketones
Aniline	Phenol
Aromatics	Pyridine
Benzene	Styrene
Borontribromide	Toluene
Chlorinated aromatics	
10.2 eV Lamp Source	
Acetaldehyde	Chlorinated hydrocarbons
Acetic acid	Chloropenes
Acetone	Cyclohexanane
Acids (organic)	Dibromochloropropene
Acrolein (acetylates)	Dichloropropylene
Alcohols	Dimethyl disulfide
Aldehydes	Dimethyl formaldehyde
Aliphatics	Dimethyl sulfide
Alkyl halides	Epichlorohydrin
Allyl alcohol	Esters
Amides	Ethanol
Amines	Ethyl methacrylate
Ammonia	Ethylene
Aniline	Ethylene dibromide
Aromatics	Ethylene imine
Arsine	Ethylene oxide
Asphalt emissions	Furan
Benzene	Heterocyclics
Bromine	Hexane
Butane	Hexamethyl phosphoric triamide
Boron tribromide	Hydrazine
Carbon disulfide	Hydrogen sulfide
Chlorinated aromatics	Hydrogen selenide

Procedure: 5607001
Revision: 0
Date: 3/85
Page: 4 of 12

10.2 eV Lamp Source (Cont'd.)

Iodine vapor	Phosphine
Isopropanol	Phosphorus trichloride
Ketones	Picolines
Lutidines	Pinene
Methyl bromide	Propylene
Methyl isocyanate	Pyridine
Methyl mercaptan	Pyrole
Methyl methacrylate	Styrene
Mineral spirits	Tetrahydrofuran
Naptha	Tetraethyl lead
Nitrates	Thionyl chloride
Nitrites	Toluene
Nitro alkanes	Vinyl acetate
Nitro benzene	Vinyl bromide
N-Octane	Vinyl chloride
Olefins	Vinylidene chloride
Phenol	
Phostoxin	

11.7 Lamp Source

Acetic anhydride	Formic acid
Acetylene	Methanol
Acrylonitrile	Methylene chloride
Alcohols	Nitrates
Aldehydes	Nitrites
Alphatics	Nitro alkanes
Alkyl halides	Phostoxin
Butane	Propane
Carbon tetrachloride	Serafume
Chloroform	
Ethane	
Ethylene dichloride	
Formaldehyde	

Procedure: 5607001
Revision: 0
Date: 3/85
Page: 5 of 12

TABLE 2 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp)

Species	Photoionization Sensitivity*
p-xylene	11.4
m-xylene	11.2
benzene	10.0 (reference standard)
toluene	10.0
diethyl sulfide	10.0
diethyl amine	9.9
styrene	9.7
trichloroethylene	8.9
carbon disulfide	7.1
isobutylene	7.0
acetone	6.3
tetrahydrofuran	6.0
methyl ethyl ketone	5.7
methyl isobutyl ketone	5.7
cyclohexanone	5.1
naptha (85% aromatics)	5.0
vinyl chloride	5.0
methyl isocyanate	4.5
iodine	4.5
methyl mercaptan	4.3
dimethyl sulfide	4.3
allyl alcohol	4.2
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
a-pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6

Procedure: 5607001
Revision: 0
Date: 3/85
Page: 6 of 12

TABLE 2 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp) (Continued)

Species	Photoionization Sensitivity*
b-pinene	0.5
citral	0.5
ammonia	0.3
acetic acid	0.1
nitrogen dioxide	0.02
methane	0.0
acetylene	0.0

*Expressed in ppm (v/v).

- o Repeatability: ± 1 percent of FSD
- o Linear range: 0.1 to 600 ppm
- o Useful range: 0.1 to 2,000 ppm
- o Response time: <3 seconds to 90 percent of full scale
- o Ambient humidity to 95% RH
- o Operating temperature: Ambient to 40°C (Instrument is temperature compensated so that a 20°C change in temperature corresponds to a change in reading of ± 2 percent full scale at maximum sensitivity).

Power Requirements and Operating Times

- o Continuous use on battery: approximately 10 hours
- o Continuous use with HNU recorder reduces instrument battery operating time to 1/2 normal time
- o Recharge time: maximum < 14 hours, 3 hours to 90 percent of full charge
- o Recharge current, maximum 0.4 amps at 15 VDC

3.0 INSTRUMENT CHECKOUT

3.1 Remove instrument box cover by pulling up on fasteners.

3.2 On the instrument panel there will be a label containing information on light source, calibration date, calibration gas, and span setting.

3.2.1 If the instrument has not been calibrated in the last 14 days or since its last field use, it should be recalibrated. Check the instrument status report form (F6265), which is maintained with the instrument in the instrument room, for its calibration history. If calibration is necessary, implement Procedure 6607001 before continuing with instrument checkout. For general

use the instrument should be calibrated to isobutylene at a span setting of 9.8.

- 3.2.2 Check the label for light source and refer to Table 1 for ionization potentials of various compounds. If the compound you wish to detect is not listed for the light sources provided with instrument, then the light source will have to be changed. Use the probe with the proper light source for the compounds to be detected.
- 3.2.3 Once it has been determined that the instrument has the correct lamp, the instrument may need to be recalibrated for the specific compound of interest. Use Procedure 6607001 to calibrate the instrument.
- 3.2.4 Check the battery supply by connecting the probe to the instrument box (see step 3.5), and turning the function switch to the battery check position (Figure 1). (Note: the battery check indicator will not function unless the probe is attached). The meter needle should deflect to the far right or above the green zone. If the needle is below or just within the green zone or the red LED indicator is on the battery should be recharged. Follow step 6.0 to recharge the battery.
- 3.2.5 Repack the instrument for shipment to the field.

4.0 FIELD INSTRUMENT SET UP

- 4.1 Remove cover by pulling up on fasteners.

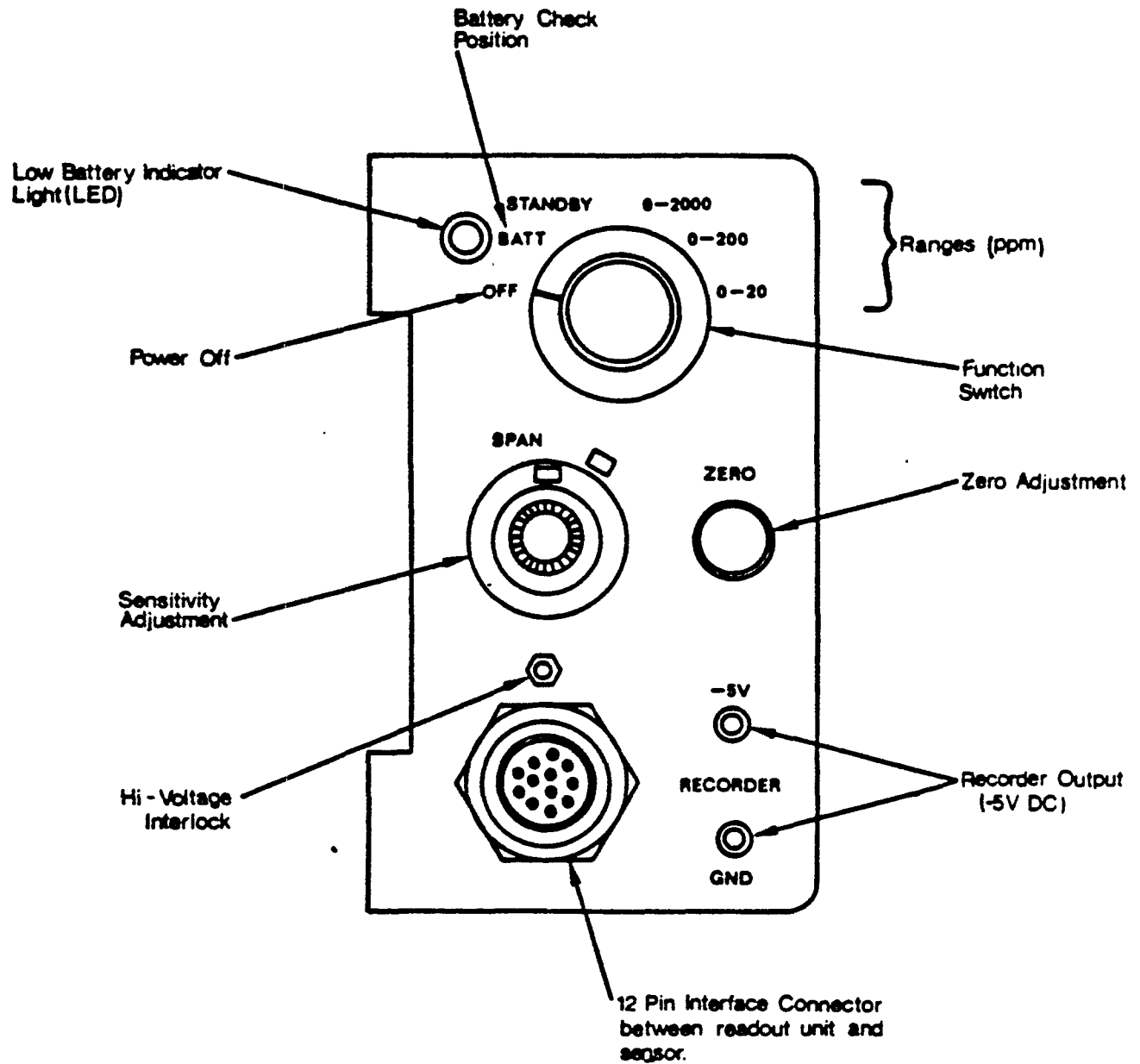


FIGURE 1 INSTRUMENT CONTROL PANEL FEATURES

- 4.2 Remove plate on cover to retrieve extension tube and carrying straps. Replace cover plate.
- 4.3 Check to see if instrument function switch is in the zero position before installing probe connector to instrument box. Turn instrument Off if found On.
- 4.4 Install 12 pin interface connector for the probe into the connector on the instrument box by carefully matching the alignment key of probe connector to the slots in the box connector. Twist the connector in a clockwise manner until a distinct snap and lock is felt.
- 4.5 Turn function switch to the battery check position. With an adequate charge, the needle on the meter should read within or above the green battery arc on the scale plate. If the needle is in the lower portion of the battery arc, the instrument should be recharged following steps 5.0 of this procedure. If the red LED comes on, the battery should be recharged.
- 4.6 To zero instrument turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclockwise rotating yields a downscale deflection. No zero gas is needed because this is an electronic zero adjustment. Wait 15 to 20 seconds to ensure that the zero reading is stable. Adjust zero setting as necessary.
- 4.7 Attach probe extension into probe.
- 4.8 Turn instrument control switch onto 0-2,000 range position.

- 4.9 Gaze at end of probe opening for blue glow of UV light source. Avoid looking directly at lamp. Blue glow indicates photoionization source is working. The instrument should not be ready to measure atmospheric contaminants.

5.0 FIELD OPERATION

- 5.1 Place function switch in 0-20 ppm range for field monitoring. This will allow for the most sensitive, quick response in detecting airborne contaminants.
- 5.2 Before entering a contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.
- 5.3 Take measurements in contaminated area, recording readings and locations. Should readings exceed the 0-20 scale, switch the function switch to the 0-200 or 0-2,000 range as appropriate to receive a direct reading. Return the instrument switch to the 0-20 range when readings are reduced to that level. Record measurements in notebook or on an appropriate form.
- 5.4 Keep in mind health and safety action guidelines for the level of protection you are wearing. Sustained readings above a certain level may force you to vacate an area or upgrade your level of protection.

Note: The instrument will not function properly in high humidity or when the window to the light housing is dirty. If the instrument response is erratic or lower than expected, implement Procedure 6607001.

5.5 When finished using the instrument reverse steps 4.1-4.5 above.

6.0 INSTRUMENT RECHARGING

6.1 The instrument should be recharged 1 hour for each hour of use or overnight for a full day's use. (The battery will last 10 hours on a full charge).

6.2 To recharge the instrument:

6.2.1 Turn function switch to the off position.

6.2.2 Remove charger from instrument top compartment.

6.2.3 Place the charger plug into the jack on the left side of the instrument box.

6.2.4 Connect the charger unit to a 120V AC supply.

6.2.5 Check charger function by turning instrument switch to the battery check position. The meter should go upscale if the charger is working and is correctly inserted into the jack.

6.2.6 Place instrument in instrument mode and charge for the appropriate time period.

6.2.7 Turn instrument off following the recharge cycle.

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 1 of 10

OPERATING PROCEDURE CENTURY PORTABLE ORGANIC VAPOR ANALYZER (OVA),
MODEL 128

1.0 INTRODUCTION

1.1 Operating Features

The Century portable organic vapor analyzer (OVA) is designed to detect and measure gases and organic vapors in the atmosphere. The instrument utilizes the principle of hydrogen flame ionization for detection. The instrument measures gases and vapors by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has been previously calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system. The sample flow rate is metered and passed through particle filters before reaching the detector chamber. Inside the detector chamber the sample is exposed to a hydrogen flame. When most organic vapors burn, they leave behind positively charged carbon containing ions which are collected by a negative collecting electrode in the chamber. An electric field exists between the conductors, surrounding the conductors, surrounding the flame and the collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated on the input electrode. The current is measured with a linear electrometer preamplifier which has an output signal proportional to the ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display. The meter display is an integral part of the Probe/Readout Assembly and has a scale from 0 to 10.

Procedure: 5607003

Revision: 0

Date: 3/85

Page: 2 of 10

The instrument consists of two major assemblies: the Probe/Readout Assembly and the Side Pack Assembly. The output meter and alarm level adjustments are incorporated into the hand held Probe/Readout Assembly. The Side Pack Assembly contains the remaining operating controls and indicators.

1.2 Controls/Indicators

1. INSTR/BATT Test Switch - A three position toggle switch that in one position turns instrument on, except pump and alarm, in second position turns all power off, and third position displays battery charge condition on the readout meter.
2. PUMP (ON-OFF) Switch - This toggle switch turns on power to the internal pump and audio alarms.
3. Ignitor Switch - This momentary push button switch connects power to the ignitor coil in the detector chamber and simultaneously disconnects power to the pump.
4. CALIBRATE Switch - This three position toggle switch selects the desired range: X1 (0-10 ppm); X10 (0-100 ppm); X100 (0-1,000 ppm).
5. CALIBRATE ADJUST (Zero) knob - This potentiometer is used to "zero" the instrument.
6. GAS SELECT Knob (span control) - This ten-turn dial readout potentiometer sets the gain of the instrument commonly referred as span control.
7. Recharger Connector - This BNC connector is used to connect the battery pack to the battery recharger assembly.
8. H₂ TANK VALVE - This valve is used to supply or close off the fuel supply from the hydrogen tank.
9. H₂ TANK PRESSURE Indicator - This high pressure gauge measures the pressure in the hydrogen fuel tank which is an indication of fuel supply.
10. H₂ SUPPLY VALVE - This valve is used to supply or close off the hydrogen fuel to the detector chamber.

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 3 of 10

11. H₂ SUPPLY PRESSURE Indicator - This low pressure gauge is used to monitor the hydrogen pressure at the capillary restrictor.
12. SAMPLE FLOW RATE Indicator - This indicator is used to monitor the sample flow rate.
13. Refill Connection - This 1/4 inch AN fitting is used to connect the hydrogen refill hose to the instrument.
14. REFILL VALVE - This valve is used to open one end of the instrument fuel tank for refilling with hydrogen.
15. Earphone Jack - This jack is used to connect the earphone; it turns off the speaker when in use.
16. VOLUME Knob - This potentiometer adjusts the volume of the internal speaker and earphone.
17. Readout and Sample Connectors - These connectors are used to connect the sample hose and umbilical cord from the Probe/Readout Assembly to the Side Pack Assembly.

2.0 Specifications

Sensitivity: 0.1 ppm (methane)

Response time: Less than 2 seconds

Readout: three ranges: 0 to 10 ppm, 0 to 100 ppm, 0 to 1,000 ppm, 250' linear scaled meter

Sample flow rate: Nominally 2 units

Fuel Supply: 75 cubic centimeter tank of pure hydrogen at maximum pressure of 2,300 PSIG, fillable while in case

Primary Electrical Power: Rechargeable and replaceable battery pack at 12 V DC

Service Life: Hydrogen supply and battery power - 8 hours minimum

Detection Alarm: Frequency modulated audible alarm. Can be preset to desired level. Frequency varies as a function of detection level.

Flame-out Indication: Audible alarm plus visual meter indication

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 4 of 10

Battery Test: Battery charge condition indicated on the readout meter or battery recharger

Probe: Telescoping adjustment over 8 inches or probe can be completely removed from readout assembly.

Filtering: In line particle filters and activated charcoal filter

3.0 OPERATION PROCEDURE

Note: A condensed operating procedure checklist is provided inside the cover of the side pack.

3.1 Instrument Setup

3.1.1 Initial Assembly

Select Survey method (normal or "close area").

1. Normal Survey Configuration:

- a. Connect the adjustable length probe to the Readout Assembly with the captive locking nut. Ensure that the probe is seated firmly in the Readout Assembly.
- b. Select the desired pickup fixture and check that a particle filter is installed.
- c. Connect the pickup fixture to the probe using the knurled locking nut.
- d. Connect the umbilical cord and sample hose to the Side Pack Assembly.

2. "Close Area" Survey Configuration:

- a. Check to ensure that a particle filter is installed in the close area sampler.
- b. Connect the close area sampler directly to the Readout Assembly.
- c. Connect the umbilical cord and sample hose to the Side Pack Assembly.

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 5 of 10

3.1.2 Fuel Supply

Check hydrogen supply by opening the H₂ Tank Valve and noting pressure. At least 1,600 pounds of pressure is required for 8 hours of usage. Refill tank if it contains less than 1,600 pounds and 8 hours of usage is required. The hydrogen supply tank is refilled following steps under 4.0 of this procedure.

3.1.3 Battery Check

Move INSTR/BATT test switch to the BATT position and note meter deflection on Readout Assembly. If the needle is below the battery mark on the readout, the battery will have to be recharged. Recharge battery following steps under 4.0 of this procedure.

3.1.4 Calibration

The instrument is normally calibrated to methane gas. When calibrated to methane gas, the GAS SELECT (span) Control is set to 300. Check the calibration label on instrument to determine date of calibration and calibration gas used. If the instrument requires recalibration, implement Procedure 6607003 before combining with this procedure.

3.2 Instrument Startup

The GAS SELECT control should be preset to the desired dial indication prior to turning instrument. This control is set during instrument calibration (Procedure 6607003) and must not be adjusted during instrument operation.

Procedure: 5607003

Revision: 0

Date: 3/85

Page: 6 of 10

1. Move Instrument (INSTR) Switch to ON and allow 5 minutes for warm up.
2. To set the audible alarm to a predetermined level (the level should be based on health and safety guideline, refer to the site health and safety plan for the action level):
 - a. Turn pump switch ON.
 - b. Adjust meter pointer to the desired alarm level using the CALIBRATE ADJUST (zero) knob.
 - c. Turn the Alarm Level Adjust knob on the back of the Readout Assembly until the audible alarm just comes on.
 - d. Adjust speaker volume with Volume Knob. If earphones are desired, adjust volume using earphones.
 - e. The instrument is now preset to activate the alarm when the level exceeds that of the setting.
3. Move the CALIBRATE Switch to X10 and adjust the meter reading to zero with the CALIBRATE ADJUST (zero) knob.
4. Check to see that the PUMP Switch is ON and observe the SAMPLE FLOW RATE Indicator. Indication should be approximately two units.
5. Open H₂ TANK VALVE one turn and observe reading.
6. Open H₂ SUPPLY VALVE one turn and observe reading. CAUTION: Do not leave H₂ SUPPLY VALVE open when the pump is not running. This will allow hydrogen to accumulate in the detection chamber.
7. Confirm that meter is still reading zero (readjust if necessary).
8. Depress ignitor button. Instrument pumps will go off. There will be a slight pop as hydrogen ignites. The meter pointer will go upscale of zero. Immediately after hearing the "pop", release ignitor button. Do not depress ingitor button for more than 6 seconds. If the hydrogen fails to ignite after 6 seconds, allow instrument to run for 2 minutes before attempting to ignite hydrogen again. If the hydrogen fails to ignite following repeated attempts at ignition, repeat entire instrument start up steps or refer to Procedure 6607003 for maintenance of the instrument.

Procedure: 5607003

Revision: 0

Date: 3/85

Page: 7 of 10

9. After ignition, the meter needle will indicate the background hydrocarbon level at area where instrument has been started. Note the background level in notebook or field log book.
10. Place CALIBRATE Switch in 1X range and move instrument to an area which is representative of the lowest ambient hydrocarbon concentration. Adjust the meter to 1 ppm with the CALIBRATE ADJUST (zero) knob. (Record all background readings.)

Note: The instrument has a low level (<0 ppm) alarm which indicates flame out. Placing or zeroing meter at 1 ppm will prevent normal background fluctuations from activating the low level alarm. This 1 ppm "zero" value must be subtracted from all measurements.

11. The instrument is now ready for field use.

3.3 Operating Procedures

1. Set the CALIBRATE switch to the 1X level. If, during taking measurements, the meter goes off scale, adjust CALIBRATE switch to 10X or 100X to record levels.
2. Take measurements at ground, waist, and head levels at all areas of the site to be surveyed. Drum openings, enclosures, etc. should be surveyed for organic vapors. Record all measurements in field log book or notebook. Record measurements relative to calibration standard, not as ppm in air.
3. When organic vapors are detected, the meter pointer will move upscale and the audible alarm will be activated if the level exceeds the preset value. The frequency of the alarm will increase as the level of exceedence is increased.
4. If the flame out alarm is actuated, ensure that the pump is running and depress the ignitor button. This should reignite the hydrogen. Flame out can be caused by explosive or oxygen deficient atmosphere. It can also be caused by constriction or blockage of the inlet tube.

3.4 Shut Down Procedure

1. Close H₂ SUPPLY VALVE.
2. Close H₂ TANK VALVE.

Procedure: 5607003

Revision: 0

Date: 3/85

Page: 8 of 10

3. Move INSTR Switch to OFF.

4. Wait 5 seconds and move PUMP Switch to OFF. The instrument is now in shut down configuration.

4.0 FUEL REFILLING

The instrument should be completely shut down for hydrogen tank refilling. The refilling should be done in a ventilated area. There should be no potential ignitors or flame in the area.

1. Attach filling hose to external source of hydrogen. Pure hydrogen of 1,600 to 2,300 psi will be required.
2. Crack open valve on hydrogen supply, place FILL/BLEED valve on hose in FILL position and purge hose for 2-3 seconds.
3. Close FILL/BLEED Valve (OFF position) and immediately attach other end of fill hose to instrument fill connection and tighten the connection.
4. Open supply valve external on hydrogen tank 1/2 to 1 turn. Set regulator to 1,600 to 2,300 psi.
5. Open the REFILL Valve and the H₂ TANK VALVE on the instrument.
6. Place FILL/BLEED Valve in FILL position. The instrument hydrogen tank should now be filling.
7. The instrument H₂ Pressure Indicator should now indicate instrument tank pressure. This pressure should approximate that of the external supply tank regulator gauge.
8. After the instrument tank is filled, shut off:
 - a. The REFILL VALVE on the instrument panel.
 - b. The FILL/BLEED Valve on the filling hose assembly.
 - c. The valve on the external hydrogen supply bottle.
9. The supply hose and internal lines on the instrument now contain hydrogen under pressure. To reduce this pressure to atmospheric pressure:
 - a. Turn FILL/BLEED Valve to BLEED position until gas can no longer be heard escaping.

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 9 of 10

- b. Turn FILL/BLEED Valve to FILL position to allow gas trapped in the connective fittings to go into the hose assembly.
 - c. Turn FILL/BLEED Valve to BLEED position to bleed off this pressure.
 - d. Turn FILL/BLEED Valve to OFF position. Keep valve in OFF position.
10. Close H₂ Tank Valve.
11. Remove fill hose from instrument. Any gas still under pressure will escape as the connector is removed. Release of gas should only be momentary.
12. As a check of the integrity of the instrument's hydrogen supply system, observe the H₂ TANK PRESSURE Indicator with the system shut down. Release of internal pressure should not go down rapidly. If there is a rapid decrease (greater than 350 PSIG/hour) with the instrument in shut down mode, there is a significant leak in the H₂ supply system. If so, the instrument should be returned to the manufacturer for repairs.

5.0 BATTERY RECHARGING

The battery should be recharged following each use of 4 hours or more, or when the battery check indicator indicates need of a charge. Never charge instrument in hazardous environment or when refilling hydrogen tank.

- 1. Remove cover from battery charge part on instrument.
- 2. Plug charger BNC connector into mating connector on battery cover and insert AC plug into 115 VAC wall outlet.
- 3. Move battery charger switch to the ON position. The light above the switch should illuminate.
- 4. Battery charge condition is indicated by the meter on the front panel of the charger; meter will deflect to the right while charging. When fully charged, the pointer will be in line with the charged mark above the scale.

Procedure: 5607003
Revision: 0
Date: 3/85
Page: 10 of 10

5. Approximately 1 hour of charging time is required for each hour of operation; 12 hours for complete charge. Do not charge for more than 24 hours.

6.0 REFERENCE

Foxboro Analytical. No date. Instruction and Service Manual, Century Systems Portable Organic Vapor Analyzer Model OVA-128 M1 2R900AC.

Procedure: 5607004
Revision: 0
Date: 3/85
Page: 1 of 7

OPERATION PROCEDURE FOR GASTECHTOR HYDROCARBON SURVEY, MODEL 1314

1.0 INTRODUCTION

1.1 Instrument Description

The Model 1314 Gastechtor Hydrocarbon Survey is a battery-powered portable instrument that can detect and indicate concentrations of combustible gas or vapor in air, in the explosibility and parts per million ranges, simultaneously with the measurement of oxygen and detection of oxygen deficiency. The instrument can detect and indicate gas concentrations up to the lower explosive limit (LEL) and actuate a characteristic audible signal if the atmospheric concentration exceeds a preset level. For the REM II program the alarm is set to sound at 20 percent of the LEL.

The instrument also analyzes for oxygen levels over the range of 0-25 percent oxygen in air. If oxygen levels reach preset low or high levels, an audible alarm, different from that of the LEL alarm, is actuated. For the REM II program, these levels are 19.5% and 25% oxygen in air.

Samples of the atmosphere under test are drawn continuously by means of a built-in pump and analyzed for combustible gas on a heated catalytic platinum element. A solid state amplifier is used to amplify indications of the catalytic element to give adequate meter deflection, even on trace gas concentrations. At the same time, the sample passes over an oxygen detector which gives an output in terms of percent oxygen.

Procedure: 5607004
Revision: 0
Date: 3/85
Page: 2 of 7

1.2 Meter Description

Indications of the instrument are displayed on a meter visible through a window on the top face of the instrument. In LEL mode, the meter reads gas concentration in units of explosivity, 0-100 percent LEL, where 100 percent LEL represents the minimum concentration of gas that will propagate as flame when placed in contact with an ignition source.

The battery check (BATT CK) mark on the scale indicates the minimum permissible battery voltage, as an indication of the state of charge of the battery.

A second scale, from 0 to 500 ppm, is used when the instrument is in the ppm range.

A third scale, reads 0-25 percent oxygen. A mark on the scale, "O₂CAL", corresponds to the normal atmospheric air concentration of 21 percent.

1.3 Controls

Six controls are used to operate the instrument.

Power switch - An orange indicator dot is exposed when instrument is on (switch is in).

Battery check - When depressed, a green dot indicates function and meter movement relative to battery check marks indicating battery level.

Procedure: 5607004
Revision: 0
Date: 3/85
Page: 3 of 7

PPM/LEL Zero - A potentiometer which is used to adjust the combustibles circuit to read zero in the absence of combustible gas.

LEL-PPM Switch - When out, the instrument is in LEL range; when in, as indicated by yellow dot, the instrument is in the sensitive ppm range.

Oxy-PPM/LEL Switch - When out, the instrument is in combustible (PPM/LEL) range; when in, as indicated by the orange dot, the instrument is in the oxygen range.

Oxy CAL - A potentiometer which is used to adjust circuit to read 21 percent when detector is surrounded by known normal air.

1.4 Indicators

A red light, blinking in an equal on-off pattern, flashes when the instrument is indicating presence of a flammable gas (i.e., atmosphere contains atmosphere with explosive gas at greater than 20 percent of its LEL).

An amber light blinks in a short-long pattern to indicate presence of abnormal oxygen conditions (i.e., less than 19.5 percent oxygen or greater than 25 percent oxygen).

A buzzer sounds when instrument is exposed to LEL or oxygen deficient conditions. The tone is continuous for LEL conditions and oxygen deficient conditions and pulsed for excess oxygen or when instrument malfunctions.

Procedure: 5607004
Revision: 0
Date: 3/85
Page: 4 of 7

2.0 SPECIFICATIONS

LEL Alarm: 20 percent LEL
PPM Alarm: 100 ppm
Oxygen Alarm: 19.5 percent (falling)
25 percent (rising)

Battery: Battery pack consists of seven 3.5 ampere hour nickel-cadmium cells in series, 9.75 volts nominal total voltage.

Pump = Motor driven diaphragm type, with a brushless DC motor.

LEL detection by catalytic oxidation on a platinum element.

3.0 OPERATION

3.1 Instrument set up:

1. Attach hose to instrument by means of the quick release fitting.
2. Put PPM/LEL and Oxy/LEL switches in out (LEL) positions with black indicators showing.
3. Press POWER switch to turn instrument on (orange indicator dot showing). Meter will normally rise upscale and pulsing or steady alarm signal may sound. Audible hum of pump will be noticed. Cause of alarm condition (combustible, oxygen, or both) can be identified by the blinking lights.
4. Press BATT CK button and note meter reading. If reading is close to or below BATT CHECK mark on meter, recharge batteries (step 4.0).
5. Allow approximately one minute for instrument to warm up and meter to stabilize. If pulsed oxygen alarm continues to sound, turn OXY CAL potentiometer clockwise to stop it. If the sound is steady, turn the potentiometer counterclockwise.

Procedure: 5607004
Revision: 0
Date: 3/85
Page: 5 of 7

6. With the hose inlet in a gas free location, turn ZERO LEL potentiometer to bring meter to "0" indication. (If impossible to reach zero with span of potentiometer, coarse zero potentiometer will have to be adjusted. This adjustment is described in Calibration and Maintenance Procedure 6607004.)
7. Next put OXY/LEL switch in OXY in position so that the orange indicator shows. Turn OXY CAL potentiometer to bring meter to the O₂ CAL mark (21 percent).

As a quick check, gently breathe into hose inlet and allow instrument to sample expired air. Reading should come down to about 16 percent and alarm should sound at 19.5 percent. Allow meter to return to 21 percent and place switch back into LEL position.

The instrument is now ready for operation.

3.2 Field Operation

1. Place instrument in either LEL, Oxygen, or PPM modes (these are described in steps 2 to 4 below). Take measurements at ground, waist, and head levels; within confined spaces; at openings of tanks, man holes, etc., and entrances to structures. Record readings and responses in log book or appropriate form.

The instrument will monitor for oxygen deficiency, abnormal oxygen levels, LEL response, and atmospheric concentrations regardless of instrument mode selected. The mode selects the meter response only. Alarms will actuate when preset levels are reached or exceeded. If the oxygen alarm is actuated when in LEL mode, switch to oxygen mode to determine oxygen level on the meter.

2. The instrument is normally operated in LEL range (i.e., the meter response will be to percent LEL). The instrument will automatically test for oxygen whenever it is used and will pulse audibly and activate the amber light alarm if oxygen content drops to 19.5 percent. If the oxygen alarm sounds or one suspects a potential oxygen deficient atmosphere, the OXY-PPM/LEL switch should be depressed (orange indicator). The meter will now indicate percent oxygen levels.

If explosive gas and abnormal oxygen levels exists simultaneously, both lights will blink in their normal pattern, but the buzzer will sound continuously.

Procedure: 5607004

Revision: 0

Date: 3/85

Page: 6 of 7

3. For readings in the LEL range, hold hose inlet at point to be tested (enclosed space, confined space, tank opening, man hole, etc.). Watch meter and observe reading as taken from upper set of graduations (0-100 percent scale). If reading rises above alarm setting (initially 20 percent LEL) pulsed red light and audible alarm will commence, and will continue as long as reading remains above alarm point. After taking reading, purge instruments with clean air prior to taking additional measurements (i.e., air away from known source of atmospheric contamination).
4. If reading in the 0-100 percent LEL range is imperceptible or very small, switch instrument to PPM range (colored indicator showing). The instrument needs to have warmed up for 5 minutes in the LEL range to use the PPM range. Rezero carefully in the LEL range before selecting the PPM range. Take reading immediately after zeroing instrument and observe maximum deflection as taken from the middle set of graduations, 0-500 PPM scale. Alarm will sound if atmospheric concentrations exceed 100 ppm.

4.0 BATTERY RECHARGE

4.1 Low Battery Indications

If the battery level, as indicated by depressing BATT CK switch and observing meter level, falls below BATT CK mark on meter, than the battery needs to be recharged.

If the battery voltage drops to below approximately 8.2 volts, the low battery alarm will sound. This is a continuous audible tone. To verify low battery level, depress BATT CK switch and note meter reading.

4.2 Battery Recharge

1. Connect charger to instrument by removing charge plug cover on instrument and inserting plug. The plug must be inserted with the This Side Up label upward. The socket is polarized with the pms offset below the center line. Do not force the plug into the socket; always check the plug alignment.

Procedure: 5607004

Revision: 0

Date: 3/85

Page: 7 of 7

2. Connect charger to 120 VAC line.
3. To verify that a charge is actually entering battery turn instrument on and check meter reading by depressing BATT CK button. The reading with charger plugged in and functioning should be higher than the reading when the charger is not functioning. If not so, recheck all connections or refer to Calibration and Maintenance Procedure 6607004.

PROCEDURE FOR OPERATION OF THE GCA MINIRAM
PARTICULATE/AEROSOL MONITOR MODEL PDM-3

1.0 INTRODUCTION

The MINIRAM (Minature Real-time Aerosol Monitor) Model PDM-3 is an ultra-compact personal-size airborne particulate monitor whose operating principle is based on the detection of scattered electromagnetic radiation in the near infrared range. The MINIRAM is a light scattering aerosol monitor of the nephelometric type that continuously senses the combined scattering from particles present within its sensing volume (approximately 1 cm^3). Air surrounding the MINIRAM passes freely through the open aerosol sensing chamber as a result of air transport caused by convection, circulation, ventilation, and personnel motion. Its scattering sensing parameters have been designed for preferential response to the particle size range of 0.1 to 10 micrometers. The MINIRAM measures the concentration of any airborne particles, both solid and liquid, and the display indicates this level in milligrams per cubic meter (mg/cm^3), based on its factory calibration using a standard test dust. The MINIRAM can be used to measure the concentration of all forms of aerosol: dusts, fumes, smokes, fogs, etc.

2.0 SPECIFICATIONS

- o Measurement ranges: 0.01 to $10 \text{ mg}/\text{m}^3$ and 0.1 to $100 \text{ mg}/\text{m}^3$
- o Precision and stability (for 10 sec. readings at 25°C):
 $\pm 0.03 \text{ mg}/\text{m}^3$ (2 sigma)
- o Precision and stability of time-averaged measurements (at 25°C):
 $\pm 0.02 \text{ mg}/\text{m}^3$ (for 1 minute averaging)

- + 0.006 mg/m³ (for 10 minute averaging)
- + 0.003 mg/m³ (for 1 hour averaging)
- + 0.001 mg/m³ (for 8 hour averaging)
- o Temperature coefficient: 0.005 mg/m³ per °C (typical)
- o Readout resolution: 0.02 mg/m³ or 0.1 mg/m³
- o Digital readout updating time: 10 seconds
- o Analog output time constant: 0.2 seconds
- o Total measurement period: 8 1/3 hours
- o Particle size range of maximum response 0.1 to 10 µm in diameter
- o Measurement display: normally 10 second real-time measurement
- o Data storage: 7 concentration average, sampling period in minutes, off-time identification number, zero value, programmable code, and check sum
- o Real time outputs analog and digital ASCII
- o Memory playback: LCD display or ASCII digital output
- o Normal battery voltage: 7.5V
- o Average battery current drain 40 mA
- o Continuous operating time with full battery charge: 10 hours (approx.)

3.0 OPERATING INSTRUMENT

3.1 Instrument Set Up

Assuming adequate battery charge (see Section 5.0), the instrument display should indicate one of the following:

1. Blank display - the instrument has been in off mode for more than 48 hours.
2. "OFF" display - the instrument has been in off mode for less than 48 hours.

3. Concentration (numeric) display - the MINIRAM is in instrument mode.

To start measurement cycle:

1. If instrument shows blank display, press OFF and wait until the display reads OFF before pressing MEAS to initiate measurement cycle.
2. If instrument shows OFF, press MEAS directly to initiate measurement cycle.

3.2 MEAS Function (Measurement)

Start monitoring operations by pressing MEAS key. The first readout is "GO", followed by last reading or 0.0. After approximately 36 seconds the first new 10-second-averaged concentration reading is displayed. All subsequent readings are concentration values in mg/m^3 , updated every 10 seconds. The MINIRAM will now run in the measurement mode for 500 minutes (8 hours and 20 minutes). Once the MEAS mode has been entered, the mode can only be interrupted by pressing the OFF key. The instrument normally operates in the 0.00 to $9.99 \text{ mg}/\text{m}^3$ range. When a 10-second concentration exceeds $9.99 \text{ mg}/\text{m}^3$ the display automatically switches to the 0.0 to $99.9 \text{ mg}/\text{m}^3$ range.

3.3 MEAS and TIME

If both MEAS and TIME are pressed at the same time, the instrument will operate continuously and will not shut down after 8.3 hours.

3.4 OFF

When this key is pressed, the instrument will discontinue whatever mode it is in and shut down to a minimum power level (blank screen) within 10 minutes to 48 hours of depressing the key.

3.5 TIME

During the measurement mode, if time is depressed, the display will show the elapsed time from the start of the measurement run. The instrument will return to the measurement mode when the key is released.

3.6 TWA (Time Weighted Average)

If the TWA key is depressed during the measurement mode, the display will indicate the TWA concentration in mg/m^3 since the start of the run.

3.7 SA (Shift-Average)

Depressing the SA key during the measurement mode will provide an 8-hour TWA concentration.

3.8 PBK (Playback)

With the instrument in the OFF mode, stored information can be played back by depressing the PBK. Depressing the key for more than 1 second will prompt the display to indicate day. First, the ID number is displayed; second, the run number (7 through 1);

third sampling time in minutes; fourth, off time between runs; and fifth, average in mg/m^3 . By depressing the PBK key for less than 1 second, stored data will be fed out for printout, etc.

3.9 ZERO

A background level or zero value is automatically subtracted from all aerosol concentration readings during the measurement mode. Pressing ZERO during a measurement period provides a momentary display of the stored zero concentration. To update this value, the MINIRAM must be in OFF mode. Then press ZERO and wait until the display again indicates "OFF". The average of 4 consecutive 10-second zero level measurements will then be stored by the MINIRAM as the new ZERO reference value. The zero update should be performed in a clean air or background relatively dust-free environment; otherwise an elevated ZERO value may be entered into the instrument. The zero check on the instrument should be performed prior to each field event.

3.10 ID

Pressing the ID key will display the instrument identification number. This number can be changed by setting the instrument into program mode. (See instruction manual for a description of the use of the program mode.)

4.0 FIELD OPERATIONS

1. Determine background value by establishing the ZERO reference value following Section 3.9. Record background value in field notebook.

2. When monitoring particulates outdoors, place monitor in stationary area within the breathing zone, and shielded from the sun or bright or reflecting lights. Excessive variable illumination of the scattering detector can result in significant measurement errors.
3. An approximate vertical position is preferred for any long-term monitoring. Ensure that the detection chamber is not blocked to air flow in the vertical position.
4. Check and record the instantaneous and time weighted average readings at the frequency specified in the health and safety plan for the site.

5.0 BATTERY RECHARGE

The battery should be recharged after each 8 hours of portable use. Minimum charge time is 12 hours. To charge the instrument:

1. Plug charger into A.C. line
2. Connect charger plug into corresponding MINIRAM receptacle
3. Leave charger connected for a minimum of 12 hours

Note: The BAT indicator bar on the LCD will display at any time the battery voltage becomes deficient.

6.0 REFERENCE

GCA Corporation. 1984. MINIRAM Personal Monitor Model PDM-3
Operations Manual.

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 1 of 8

PROCEDURE FOR DETERMINATION OF DISSOLVED OXYGEN, YSI MODEL 57 DISSOLVED OXYGEN METER

1.0 INTRODUCTION

The YSI Model 57 Dissolved Oxygen Meter is intended for dissolved oxygen and temperature measurement in water and wastewater applications, but is also suitable for use in certain other liquids. Dissolved oxygen is indicated in mg/l on 0-5, 0-10, and 0-20 mg/l scales. Temperature is indicated in 0°C on a -5°C to 45°C scale. The dissolved oxygen ranges are automatically temperature compensated for solubility of oxygen in water and permeability of the probe membrane, and manually salinity compensated.

The probe has Clark-type, membrane-covered polarographic sensors with built in thermistors for temperature measurement and compensation. A thin permeable membrane stretched over the sensor isolates the sensor elements from the environment, but allows oxygen and other gases to enter. When a polarizing voltage is applied across the sensor, oxygen that has passed through the membrane reacts at the cathode, causing a current to flow. The membrane passes current at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the absolute pressure of oxygen outside the membrane. If oxygen pressure increases, more oxygen diffuses through the membrane and more current flows through the sensor. A lower pressure results in less current. The current is registered on the O₂ meter to reflect dissolved O₂ levels.

2.0 SPECIFICATIONS

2.1 Instrument

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 2 of 8

1. Oxygen Measurement

Ranges: 0-5, 0-10, and 0-20 mg/l

Accuracy: $\pm 1\%$ of full scale at calibration temperature

Readability: 0.025 mg/l on 0.5 scale; 0.05 mg/l on 0-10 scale; 0.1 mg/l on 0-20 scale.

2. Temperature Measurement

Range: -5°C to $+45^{\circ}\text{C}$

Accuracy: $\pm 0.5^{\circ}\text{C}$ plus probe which is $\pm 0.1^{\circ}\text{C}$

Readability: 0.25°C

3. Temperature Compensation

$\pm 1\%$ of D.O. reading for measurements made within $\pm 5^{\circ}\text{C}$ of calibration temperature.

$\pm 3\%$ of D.O. reading over entire range of -5 to 45°C probe temperature.

4. System Response Time

90% in 10 seconds at constant temperature of 30°C with YSI 5775 membrane.

5. Operating Temperature Range

-5° to $+45^{\circ}\text{C}$. Large ambient temperature changes will result in 2% loss of accuracy unless red line and zero are reset.

6. Recorder Output

0 to 114 - 136 mV. Recorder should have 50,000 ohms minimum input impedance.

7. Power Supply

Two disposable "C" size carbon zinc batteries (Eveready 935C or equal) providing approximately 1,000 hours of operation.

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 3 of 8

2.2 Probe

1. Cathode: gold
2. Anode: silver
3. Membrane: 0.001 inch teflon
4. Electrolyte: half saturated KCl
5. Temperature Compensation (see instrument specification)
6. Pressure compensation: Effective 0.5% of reading with pressure to 100 psi (230 feet of seawater)
7. Polarizing Voltage: 0.8 volts nominal
8. Probe current: Air at 30°C = 19 microamps nominal
Nitrogen at 30°C = 0.15 microamps or less

3.0 OPERATING PROCEDURES

3.1 Required Equipment

YSI Model 57 Oxygen Meter
YSI5740 detachable cable
YSI5739 probe
Clean cloth
Distilled water

3.2 Preparation of the Probe

A YSI 5739 D.O. Probe is used with the instrument. All probes are shipped dry from the factory and must be filled with electrolyte prior to operation. To fill or replace the electrolyte, maintenance steps 2.4 in Procedure 6617001 should be followed.

If the probe is not connected to the cable, it can be reconnected using the following steps:

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 4 of 8

1. Inspect the connector and O ring for cleanliness and condition. Clean if dirty, replace O ring if frayed or damaged.
2. Push the electrical connector into the probe body, rotating it until the two halves mate. A light coating of vaseline or silicone grease on the "O" ring will make reassembly easier. Air trapped between the connector halves may cause them to spring apart slightly; this is normal.
3. Hand tighten the retaining nut.
Note: the connectors are not intended for frequent disconnecting. Therefore, it is best to keep the probe connected to the cable.

3.3 Preparing the Instrument

3.3.1 The instrument must be placed in its intended operating position - vertical, tilted back, or on its back - before it is prepared for use and calibrated. Readjustments may be necessary when the instrument operating position is changed.

3.3.2 To Prepare the Instruments

1. With the switch in the off position, adjust the meter pointer to zero with the screw in the center of the meter panel. Readjustments may be necessary if the instrument position is changed.
2. Move switch to RED LINE and adjust RED LINE knob until the meter aligns with the red mark at 31°C position. If the needle will not reach the red line, the battery will have to be replaced.
3. Move switch to zero and adjust zero knob until meter aligns with zero mark.
4. Attach the prepared probe cable to the probe connector on the instrument body and adjust the retaining ring finger tight.

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 5 of 8

5. Before calibrating, allow 15 minutes for optimum probe stabilization. Repolarize (steps 1 to 4) whenever the instrument has been off or the probe has been disconnected.

3.4 Field Calibration

3.4.1 Calibration Methods

Three calibrations methods are available to calibrate the instrument: Winkler Titration, Saturated Water, and Air. However, because Winkler Titration and Saturated Water calibration require either calibration items or calibration times that may be prohibitive for hazardous waste site conditions, only the Air method is represented here. A description of the Winkler Titration calibration methods are presented in calibration and maintenance Procedure 6617001.

3.4.2 Air Calibration

1. Place probe in moist air. This is done by wrapping the probe loosely with a damp cloth. Care must be taken so that the cloth does not touch the membrane. Wait approximately 10 minutes for temperature stabilization.
2. Adjust knob to TEMPERATURE and read valve. Refer to Table 1 and determine calibration value.
3. Determine altitude or atmospheric correction factor from Table 2.
4. Multiply the calibration value from Table 1 by the connection factor from Table 2. This will provide a corrected calibration value.
5. Adjust the main knob to the appropriate setting for the converted calibration value and set the Salinity knob to 0.

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 6 of 8

6. Adjust the CALIBRATE knob until the meter reads the corrected calibration value from step 4.
7. Wait two minutes to verify calibration stability. Readjust as necessary.

The probe is now calibrated and should hold the calibration for many measurements. Calibration can be disturbed by physical shock, touching the membrane, or drying out of electrolyte. It is best to pre-check calibration after each series of measurements.

3.5 Dissolved Oxygen Measurement

1. With instrument prepared for use and the probe calibrated, place the probe into the sample to be measured.
2. If sample is not already being physically stirred (i.e., running water), stir sample by moving probe up and down in the liquid or container at about 1 foot per second rate.
3. Adjust salinity knob to the salinity of the sample. (If salinity is unknown, it will have to be determined with a conductivity meter).
4. Allow sufficient time for probe to stabilize to sample temperature and dissolved oxygen.
5. Select meter setting to reflect range of D.O. concentration. Read dissolved oxygen level on meter and record on appropriate form or in log book.
6. When finished taking D.O. measurements, turn instrument off. Check sponge or paper in probe bottle cover for dampness. Dampen sponge or paper with distilled water if dry. Place bottle cover over probe to keep electrolyte from evaporating.

4.0 REFERENCE

Yellow Springs Instrument Company, 1983. Instruction Manual YSI Model 57 Dissolved Oxygen Meter.

Procedure: 5617001

Revision: 0

Date: 3/85

Page: 7 of 8

TABLE 1 - SOLUBILITY OF OXYGEN IN FRESH WATER

Temperature 'C	mg/l Dissolved Oxygen	Temperature 'C	mg/l Dissolved Oxygen
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.05
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.61
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.31
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.95

Source: Derived from 15th Edition "Standard Materials for the Examination of Water and Wastewater."

Procedure: 5617001
Revision: 0
Date: 3/85
Page: 8 of 8

TABLE 2 - ALTITUDE CORRECTION FACTOR

Atmospheric Pressure mmHg	or	Equivalent Altitude Ft.	=	Correction Factor
775		540		1.02
760		0		1.00
745		542		.98
730		1094		.96
714		1688		.94
699		2274		.92
684		2864		.90
669		3466		.88
654		4082		.86
638		4756		.84
623		5403		.82
608		6065		.80
593		6744		.78
578		7440		.76
562		8204		.74
547		8939		.72
532		9694		.70
517		10472		.68
502		11273		.66

Source: Derived from 15th Edition "Standard Materials for the Examination of Water and Wastewater."

OPERATION PROCEDURE YSI MODEL 33
S-C-T METER (SALINITY, CONDUCTIVITY, TEMPERATURE)

1.0 INTRODUCTION

The YSI Model 33 is a portable battery powered, transistorized instrument used to measure salinity, conductivity, and temperature in surface, ground water, and waste streams. Conductivity is expressed as micromhos/centimeter (umhos/cm; note: the "umhos/cm" on the meter is abbreviated "umho"). These are measurements of the electrical conductance the sample would show if measured between opposite faces of a 1 cm cube. Salinity is the number of grams of salt per kilogram of sample (0/00 = parts per thousand). This measurement assumes the sample contains a "standard" sea water salt mixture. The sample temperature is measured in degrees Celsius.

Salinity measurements are manually temperature compensated by direct dial. Conductivity measurements are not temperature compensated; however, a temperature function is provided on the instrument to aid with calculation of corrections. Also, when just temperature and conductivity are known, it is possible to calculate salinity, and when only temperature and salinity are known, it is possible to calculate conductivity.

2.0 Specifications

2.1 Conductivity

Ranges: 0-500, 0-5,000, and 0-50,000 umhos/cm with YSI 3300 Series Probes.
Accuracy: + 2.5% max. error at 500, 5,000, and 50,000 plus probe. + 3.0% max. error at 250, 2,500 and 25,000 plus probe.
Readability: 2.5 umhos/cm on 500 umho/cm range
25 umhos/cm on 5,000 umho/cm range
250 umhos/cm on 50,000 umho/cm range

Temperature Compensation: None

2.2 Salinity

Range: 0-40 ‰ in temperature range of -2 to +45°C
Accuracy: Above 4°C, ± 0.9 ‰ at 40 ‰ and
 ± 0.70 ‰ at 20 ‰ plus conductivity probe.
Below 4°C, ± 1.1 ‰ at 40 ‰ and
 ± 0.9 ‰ at 20 ‰ plus conductivity probe
Readability: 0.2 ‰ on 0-40 ‰ range
Temperature compensation: Manual by direct dial from -2 to +45°C.

2.3 Temperature

Range: -2 to 50°C
Accuracy: ± 0.1 °C at -2°C; ± 0.6 °C at 45°C plus probe
Readability: ± 0.15 °C at -2°C to ± 0.37 °C at 45°C

2.4 Power Supply

Two D-size alkaline batteries, Eveready E95 or equivalent, providing approximately 200 hours of operation.

2.5 Probe

YSI 3300 Series conductivity/temperature probe
Normal Probe Constant: $K = 5/\text{cm}$
Accuracy: $\pm 2\%$ of reading for conductivity and salinity
Error: ± 0.1 °C at 0°C and ± 0.3 °C at 40°C

2.6 Instrument Ambient Range

Satisfactory operation -5 to +45°C. A maximum error of $\pm 0.1\%$ of the reading per °C change in instrument temperature can occur. The error is negligible if the instrument is readjusted to redline for each reading.

3.0 OPERATION PROCEDURE

3.1 Set Up

- 3.1.1 Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with zero on the conductivity scale.
- 3.1.2 Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter lines up with the redline on the meter face. If this cannot be accomplished, replace the batteries.

3.1.3 Plug the probe into the probe jack on the side of the instrument.

3.2 Temperature Measurements

3.2.1 Place probe in solution to be measured.

3.2.2 Set probe mode to Temperature.

3.2.3 Allow five minutes for probe to come to equilibrium with temperature of water before taking reading.

3.2.4 Read temperature on the bottom scale of the meter in degrees Celsius and record on appropriate form or log book.

3.3 Salinity Measurement

3.3.1 Transfer the temperature reading from step 2.2.4 to the 'C scale on the instrument.

3.3.2 Switch the MODE control to the SALINITY position and read salinity on the red 0-40 0/00 meter range. Record on appropriate form or log book.

3.3.3 Depress the CELL TEST button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. Clean the probe and re-measure.

3.4 Conductivity Measurement

3.4.1 Switch the MODE control to the X100 scale. If the reading is below 50 on the 0-500 range, switch to the X10 scale. If the reading is still below 50, switch to the X1 scale.

3.4.2 Read the meter scale and multiply the reading by appropriate scale factor. The answer is expressed in umhos/cm. Measurements are not temperature compensated. Record measurement on appropriate form or log book.

3.4.3 When measuring on the X10 and X100 scales, depress the CELL TEST button. The meter reading should fall less than 2%; if greater the probe is fouled and the measurement is in error. Clean probe and remeasure.

3.5 Error Calculation

3.5.1 Temperature

Use Figure 1 to calculate error for probe and instrument versus °C meter reading.

Example: Meter reading 15°C
Error from Figure 1 0.4°C
Accuracy: $15^{\circ}\text{C} \pm 0.4^{\circ}\text{C}$ for probe and instrument combined

3.5.2 Conductivity

Use Figure 2 to determine the worst case conductivity error as a function of the conductivity reading for the probe and instrument combined.

Example: Meter Reading: 360 umhos/cm on X10 scale
% Reading error from Figure 2 $\pm 4.5\%$
Accuracy: $3,600 \pm 162$ umhos/cm for probe and instrument.

3.5.3 Salinity

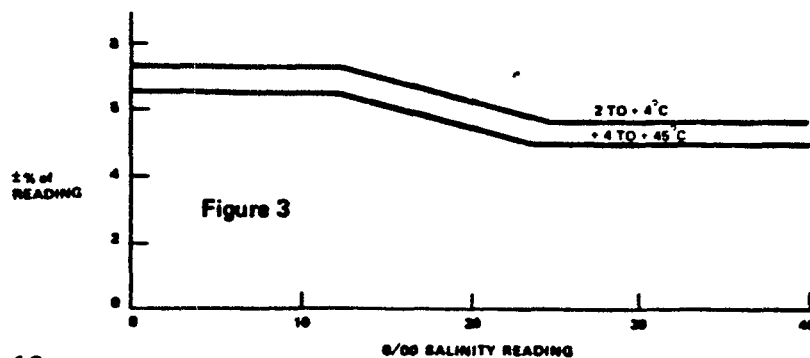
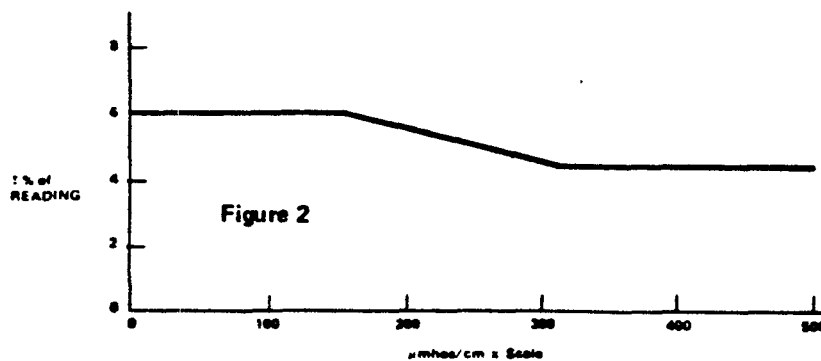
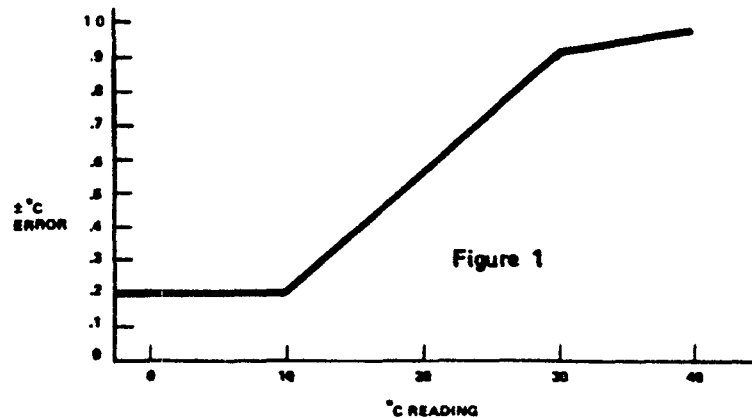
The salinity readings are a function of temperature and conductivity, therefore the accuracy is a function of both. Use Figure 3 to derive the total error of the temperature and conductivity probe.

Example: Meter Reading: 10 0/00, @ 10°C
% of Reading Error
From Figure 3: 6.5%
Accuracy: $10\ 0/00 \pm 0.65\ 0/00$ for all errors, combined worst case

3.0 REFERENCE

Yellow Springs Instrument Co., Inc. No date. Instructions for YSI Model 33 and 33M S-C-T meters.

Procedure: 5617002
 Revision: 0
 Date: 3/85
 Page: 5 of 5



OPERATION PROCEDURE FOR HAAKEBUCHLER pH STICK

1.0 INTRODUCTION

The HaakeBuchler pH Stick is a portable pH monitoring instrument for determining pH in surface and ground waters, waste streams and other water quality applications. The pH Stick consists of a plastic bodied, gel filled, combination electrode and a miniaturized precision meter with liquid crystal display (LCD). The electrode incorporates a temperature sensor which provides automatic compensation for electrode temperature effects from 0 to 45°C.

2.0 SPECIFICATIONS

Instrument - None specified by the manufacturer.

Batteries - Uses seven V312HM mercury type (or equivalent) cells; 7.75 mm diameter; 3.50mm thickness; minimal voltage per cell of 1.35 volts.

3.0 OPERATION

3.1 Field Calibration

The instrument requires field calibration prior to each use. Distilled water, buffer solution (pH 7) and pH 4 solution are required for the field calibration. All solutions must be at the same temperature. This reduces time to stabilize and improves accuracy.

To calibrate the instrument:

1. Remove the protective sheath and rinse the electrode in distilled water.
2. Place the electrode in the pH 7 buffer solution, depress the white operation button below the LCD display, and allow the reading to stabilize.
3. Adjust the pH 7 control using the tool on the end of the protective sheath. The pH 7 control is the upper most white control on the right side of the instrument. Adjust the pH control until the meter reads pH 7.
4. Rinse the electrode in distilled water.
5. Place the electrode in pH 4 solution, depress the white operation button, and allow the reading to stabilize.
6. Adjust the slope control (white control below pH 7 control on right side of instrument) until the meter reads the correct value of the pH 4 solution.
7. Rinse probe in distilled water.
8. Repeat steps 2 through 7.
9. Record calibration in field log or on appropriate form.

3.2 pH Measurements

To take pH measurements:

1. Remove protective sheath (if on) and rinse electrode in distilled water.
2. Place electrode in water sample, depress white control button, wait for reading to stabilize, and record reading in field log book or on appropriate form.
3. Rinse electrode in distilled water between each measurement and after the last sample is measured.

3.3 Instrument Storage

Always rinse the electrode in distilled water prior to replacing the protective sheath. Do not let the electrode dry out. The absorbent pad at the bottom of the sheath must be kept saturated with pH 7 buffer solution. Following each use, place buffer solution in the sheath prior to inserting the electrode. As a temporary measure, the instrument may be stored in distilled water. The distilled water should be replaced with pH 7 buffer at the earliest possible opportunity.

When not in use, place pH sticker in the wallet provided and store in dry place.

PROCEDURE FOR DETERMINING TEMPERATURE OF GROUNDWATER

1.0 INTRODUCTION

The temperature of ground water is important for numerous applications. For example, temperature measurements are critical in identifying recharge from nearby surface-water sources. For accurate geochemical evaluation of equilibrium thermodynamics, it is desirable to know the temperature of the water in the aquifer within $\pm 0.1^{\circ}\text{C}$.

The temperature is recorded by a mercury-filled thermometer that is permitted to equilibrate in a sample that is continuously pumped into a dewar flask. The well should be pumped continuously until three identical consecutive readings of temperature are obtained.

The foregoing method may be used to measure the temperature of any ground water sample but is most accurate when the ambient temperature is within 20°C of the ground-water temperature. New or little-used wells may develop new producing zones during pumping, thereby varying the proportion of water entering the well from different depths and causing either an instantaneous change or continual drift in the temperature measurements. Drawdown may cause dewatering of certain beds and may cause a change in the temperature. Pumping time insufficient to allow equilibration of water temperature in the casing and pump column will also cause drifting of the temperature.

2.0 APPARATUS

1. Dewar flask (a thermos bottle with a narrow mouth is adequate).
2. Partial immersion thermometer calibrated in 0.1°C or 0.2°F with the usual range of $0-50^{\circ}\text{C}$, or any range expected in the ground water in the study area. Steel or brass armor should be used to minimize breaking the thermometer. The thermometer should be

accurate to +1°C as checked against the Bureau of Standards calibrated thermometer.

3.0 PROCEDURE

Samples should be collected as close to the wellhead as possible. A continuous stream of water should be conducted through a short plastic tube into the bottom of the flask, allowing a continuous flow of water from the flask. Readings should be taken after 5 minutes of flow at 1 minute intervals and recorded until no change is observed. If collection by continuous flow is impossible, the sample should be collected in the dewar flask and stoppered, with the thermometer inserted through the access hole. The first sample should be allowed to equilibrate 1 or 2 minutes and should then be discarded. The flask should be quickly refilled, and the temperature should be recorded immediately. This process should be continued until three identical consecutive readings are obtained. A box similar to that shown in Figure 1 is useful for carrying equipment and preventing breakage.

4.0 REFERENCE

USGS, 1984 National Handbook of Recommended Methods for Water-Data Acquisition.

Procedure: 5617004
Revision: 0
Date: 4/85
Page: 3 of 3

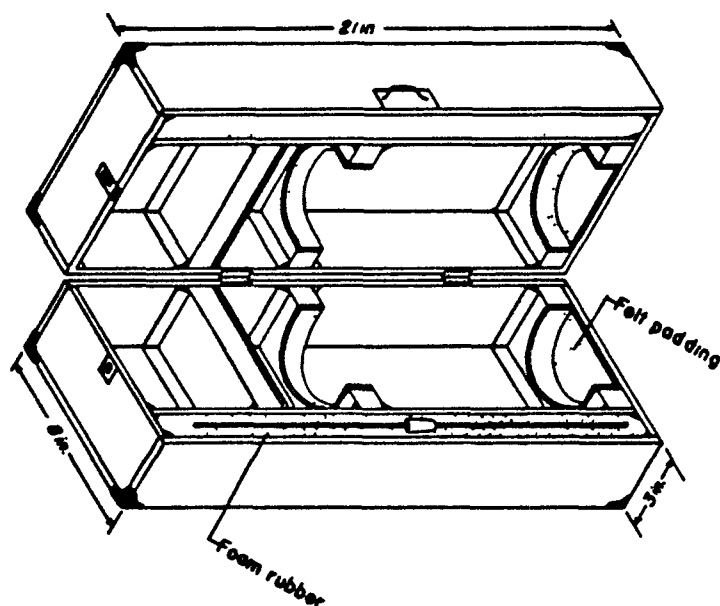


Figure 1 - Carrying box for thermometer, reading lens, and dewar flask

PROCEDURE FOR FILTRATION OF SAMPLES

1.0 INTRODUCTION

The sampler should carefully review any proposed procedures for filtering samples on site. Filtration of samples in which volatile organic constituents are of interest is not recommended, since filtration may strip these constituents from the sample. However, filtration of samples in which metals are the constituents of concern may be applicable depending on the proposed analytical method. If total recoverable methods are to be used, the sample should not be filtered. However, if measurement of dissolved metals is desired, the sample should be filtered on site.

The use of filtering in the dissolved method is designed to remove particulate matter drawn during sampling into the well, through the screen, from the surrounding geologic materials. These particulates may have adsorbed constituents that, once a preservative (particularly acid) is added, may become dissolved in the sample. Thus, if samples truly representative of in-situ ground-water quality are desired, filtering should be required. However, if the goal is simply to detect in the subsurface the presence of a constituent, filtering may not be recommended. Analyzing unfiltered samples may, accordingly, be particularly suitable for detection monitoring. However, establishment of a suitable background may become a problem because water-quality measurements may be strongly influenced by the design and construction of individual wells and the grain size distribution of the formation in which the intake of each well is located. The sampler will need to determine which method is most appropriate for each particular program. In some cases both filtered and unfiltered samples may be collected and compared.

If mineral precipitation is observed during filtration or if the chemical species of interest are suspected to be significantly present in colloidal form, an unfiltered acidified sample should also be collected and subsequently analyzed for the same parameters as the filtered sample. The containers for the filtered and unfiltered samples must be so labeled and appropriately identified in the field notes.

2.0 PROCEDURE

If filtration is required, the use of a 0.45 micron filter is generally considered appropriate. Occasionally well or surface waters may contain high concentrations of Total Suspended Solids (TSS) such that the 0.45 micron filters will clog during filtering. To avoid clogging, prefilters, available commercially, should be used in addition to the 0.45 micron filters. The filter should also be made of materials compatible with the chemical characteristics of the ground water samples.

Filtration of ground water samples will be performed when appropriate, as summarized in the table below.

<u>Analysis</u>	<u>Sample Collection</u>	
	<u>Filtered</u>	<u>Non-Filtered</u>
Volatile Organics	No	Yes
Total Metals or Ions	No	Yes
Dissolved Metals or Ions	Yes	Sometimes
(acidify after filtration)		

3.0 REFERENCE

U.S. EPA, 1983. Test Methods for Evaluating Solid Waste. SW-846.

Procedure: 5617007
Revision: 0
Date: 4/85
Page: 3 of 3

U.S. EPA, 1983. Methods for the Chemical Analysis of Water and Wastes. March 1983. EPA-600/4-79-020.

Geotrans, Inc., 1983. RCRA Permit Writer's Manual: Ground Water Protection (40 CFR Part 264, Subpart F), EPA Contract no. 68-01-6464.

Scalf, M.R., McNabb, J.F., Dunlap, W.J., Cosby, R.L., Fryberger, J., 1981. Manual of Ground-Water Sampling Procedures. NWWA/EPA Series.

PROCEDURES FOR WATER LEVEL MEASUREMENT

1.0 INTRODUCTION

Water-level measurements are fundamental to ground-water and solute transport studies. Some of the major uses of water-level data are to indicate the directions of ground-water flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the ground-water system, to define the hydraulic characteristics of aquifers, and to evaluate stream aquifer relations. Uses for water level data are listed below:

1. Monitor the effect of mining or subsurface disposal operations.
2. Indicate the change in water level due to distribution or rate of regional groundwater withdrawal.
3. Show the relationship of groundwater to surface water.
4. Provide long-term records that can be used to evaluate the effect of management and conservation programs.
5. Estimate the amount, source, and area of recharge and estimate discharge.
6. Estimate the hydraulic characteristics of an aquifer.
7. Estimate evapotranspiration.
8. Estimate rate and direction of groundwater movement.
9. Delineate reaches of losing or gaining streams or canals.
10. Indicate the status or change in groundwater storage.

Water level should be measured at each site prior to well evacuation, sampling or other disturbance of the water table. Water level measuring techniques and their applications are summarized on Table 1.

[X indicates applicability of the methods]

Method	APPLICATION					Advantages	Disadvantages
	Water-level measurements 500 ft or less	Water-level measurements in 1,500-ft range	Observation of natural water-level fluctuation	Pumping test ¹ where fluid-level changes are large	Hydraulic tests with small fluid-level changes (0.2 ft)		
Steel tape	X	X		possible	possible	Most precise method.	Slow, must remove from well to read; delicate.
Electric cable	X	X	Non-recording devices.	X	X	Rugged, simple, adequate field precision. ²	Large instrumental error; required periodic calibration.
Air line	X	X		X	Lacks precision.	Fast, simple, not affected by foam. Precision depends on air gauge used.	Needs air compressor, air line must be airtight, limited by gauge inaccuracies.
Mechanical Recorder	X		X	X	X	Precise, permanent record.	Limited to relatively straight holes less than 1,000-ft deep.
Transducer Systems	X	X	X	X	Possible, lacks precision at present.	High-speed response, permanent record.	Needs frequent attention.

¹ Or other hydraulic test including packer test.

² High resolution (0.01 ft) when kept in hole for measuring small water level fluctuation.

Table 1 - Applications of Water Level Measuring Techniques
(Modified from Garber and Koopman, 1968).

Procedure: 5619007
Revision: 0
Date: 4/85
Page: 2 of 12

2.0 MEASURING POINTS AND REFERENCE POINTS

For comparability, water-level measurements must be referenced to the same datum (elevation). The measuring point is measured in reference to land surface datum and is the most convenient place to measure the water level in a well. Measurement points change from time to time, especially on private wells. The measuring-point correction of a water-level measurement converts the measurement to a distance above or below land surface at the well.

The measuring point must be as permanent as possible, clearly defined, marked, and easily located. If at all possible, position the point so that a leveling rod can be set on it directly over the well and the measuring tape can hang freely when it is in contact with the measuring point. Frequently, the top of the casing is designated as the measuring point; because the top of the casing is seldom smooth and horizontal, a particular point should be designated and marked clearly with paint and, if permitted, the letters MP with an arrow.

The reference point for water-level measurements is an arbitrary datum established by permanent marks set on or near the well. It is used to check the measuring point, and its greatest value is in re-establishing a measuring point if one is destroyed or changed.

3.0 PROCEDURES

3.1 Graduated Steel Tape

The graduated steel tape method is considered to be the most accurate method for measuring the water level in nonflowing wells. Steel surveying tapes in lengths of 100, 200, 300, 500, and 1,000 feet are commonly used. A black tape is better than a chromium-plated tape. The tapes are mounted on hand-cranked

reels up to 500-ft lengths; for greater depths a motor-driven tape drive is usually required. A slender weight is attached to the ring at the end of the tape to insure plumbness and to permit some feel for obstructions.

The lower few feet of tape is chalked by pulling the tape across a piece of blue carpenter's chalk. The wet chalk mark identifies the portion of the tape that was submerged. Lower the graduated steel-tape from the measuring point at the top of the well until a short length of the tape is submerged. The weight and tape should be lowered into the water slowly to prevent splashing. Submergence of the weight and tape may temporarily cause a water-level rise in wells or piezometers having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity. Under dry surface conditions, it may be desirable to pull the tape from the well by hand, being careful not to allow it to become kinked, and reading the water mark before rewinding the tape onto the reel. In this way, the water mark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. Read the tape at the measuring point, and then read the water mark on the tape. The difference between these two readings is the depth to water below the measuring point.

Errors resulting from the effects of thermal expansion of tapes and of stretch due to the suspended weight of the tape and plumb weight can become significant at high temperatures and for measured depths in excess of 1,000 feet.

As a standard of good practice, the observer should make two measurements. If two measurements of static water level made

within a few minutes do not agree within about 0.01 or 0.02 foot (generally regarded as the practical limit of precision) in observation wells having a depth to water of less than a couple hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the hole or covering its wall, it may be impossible to get a good water mark on the chalked tape.

3.2 Electrical Methods

Many types of electrical instruments have been devised for measuring water levels; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Some instruments consist of a single conductor that is lowered into the well where the metal well casing is used as the second conductor. More commonly, a two-conductor cable and special probe are used. Various forms of electrolytic cells using two electrodes of dissimilar metals have been used, but current is more commonly supplied by batteries.

Ordinarily, two-conductor electric tapes are 500-ft long and are mounted on a hand-cranked reel that contains space for the batteries and some device for signaling when the circuit is closed. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the hole. The electric tapes generally are marked at 5-ft intervals with clamped-on metal bands.

Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator. The probe should be lowered slowly into the well

until contact with the water surface is indicated. The electric tape is marked at the measuring point and partly withdrawn; the distance from the mark to the nearest tape band is measured and added to (or subtracted from) the band reading to obtain the depth to water. It is good practice to take a second or third check reading before withdrawing the electric tape from the well. The tape should not rub across the top of the casing because the metal bands can become displaced.

Electric tapes are more cumbersome and inconvenient to use than the wetted-tape method, and they normally give less accurate results. In some situations, however, they are superior. Where water is dripping into the hole or covering its walls, it may be impossible to get a good water mark on the chalked tape. In wells that are being pumped, particularly with large-discharge pumps, the splashing of the water surface makes consistent results by the wetted-tape method impossible. Where a series of measurements are needed in quick succession, such as in pumping tests, electric tapes have the advantage of not having to be removed from the well for each reading. Electric tapes are also safer to use in pumping wells because the water is sensed as soon as the probe reaches the water surface and there is less danger of lowering the tape into the pump impellers.

Independent electric tape measurements of static water levels using the same tape should agree within ± 0.04 foot for depths of less than about 200 feet. At greater depths, independent measurements may not be this close. For a depth of about 500 feet, the maximum difference of independent measurements using the same tape should be within ± 0.1 foot.

In wells having a layer of oil floating on the water, the electric tape will not respond to the oil surface and, thus, the

fluid level determined will be different than would be determined by a steel tape. The difference depends on how much oil is floating on the water. A miniature float-driven switch can be put on a two-conductor electric tape that permits detection of the surface of the uppermost fluid. The electric tape should be decontaminated after measurements in each well.

It is especially important to check the electric line length by measuring with a steel tape after the line has been used for a long time or after it has been pulled hard in attempting to free the line. Some electric lines, especially the single line wire, are subject to considerable permanent stretch. In addition, because the probe is larger in diameter than the wire, the probe can become lodged in a well. Some operators attach the probe by twisting the wires together by hand and using only enough electrical tape to support the weight of the probe. In this manner, the point of probe attachment is the weakest point of the entire line. Should the probe become "hung in the hole", the line may be pulled and breakage will occur at the probe attachment point, allowing the line to be withdrawn.

3.3 Air Line

The air line method is especially useful in pumped wells where water turbulence may preclude using more precise methods. A small diameter air-type tube of known length is installed from the surface to a depth below the lowest water level expected. Compressed air (compressor, bottled air, or tire pump) is used to purge the water from the tube. The pressure, in pounds per square inch (psi), needed to purge the water from the air line multiplied by 2.31 (feet of water for one psi) equals the length in feet of submerged air line. The depth to water below the center of the pressure gage can be easily calculated by

subtracting the length of air line below the water surface from the total length of air line (assuming the air line is essentially straight).

Accuracy depends on the precision to which the pressure can be read. The accuracy of an air line or pressure gage measurement depends primarily on the accuracy and condition of the gage but is normally within one foot of the true level as determined by means of a steel-tape measurement. The air lines themselves, however, have been known to become clogged with mineral deposits or bacterial growth or to develop leaks and consequently yield false information. A series of air-line measurements should be checked periodically by the use of a steel tape or an electric water-level indicator.

The air line and any connections to it must be airtight throughout its entire length. If the line is broken or leaky, large errors may occur. A long-term increase in air line pressure may indicate a gradual clogging of the air line. A relatively sudden decrease in air line pressure may indicate a leak or break in the air line. Air line pressures that never go above a constant low value may indicate that the water level has dropped below the outlet orifice of the air line. To minimize the effect of turbulence, the lower end of the air line should be at least five feet above or below the pump intake. Corrections should be made for fluid temperatures much different from 20°C and for vertical differences in air density in the well column for cases where the depth to water is very great.

3.4 Recording Devices

Devices for recording changes in water levels may be mechanical, electronic, or electromechanical. A further distinction is the

manner in which the device detects changes. A float or an electromechanically actuated water-seeking probe may be used to detect vertical changes of the water surface in the hole, or a mechanical or electrical pressure gage submerged several feet below the water surface may be used to detect changes in fluid pressure resulting from water-level changes. The principal advantage of pressure-sensing devices is that they may be used in packed or otherwise sealed-off zones in a well. In addition, their response to rapid changes of fluid pressure is generally better than that of mechanical devices. An increasing number of digital punched-tape recorders that record levels at prescribed times are being used on observation wells. However, the simplest recording device commonly in use consists of a recording chart drum rotated mechanically by a free float that follows the water level, while a clock drive moves a recording pen horizontally across the chart.

Where depth to water is more than a few feet below the top of the casing, special care must be taken to minimize friction between the float cable and the walls of the well. The float selected should be the largest diameter that can be accommodated by the casing. The error resulting from float-line drag along the well casing is larger than the error caused by float drag. If the clearance between the float and the casing is small, the float cable should be arranged so that the counterweight does not have to pass the float, but is always above or below the water level. When the counterweight is immersed, a little extra weight should be used to counteract the water's buoyancy.

Water-level recorders should be protected from the weather and vandalism by a suitable shelter that is solidly anchored. The part of a recorder most susceptible to malfunction is the clock. To insure continuous records, field personnel who visit recorders

Procedure: 5619007
Revision: 0
Date: 4/85
Page: 10 of 12

should carry spare clocks. Malfunctioning clocks should be sent to a reliable clock-repair service for maintenance, and all clocks should be cleaned and adjusted periodically.

During each visit to a recorder installation, the water level should be measured (preferably by the wetted-tape method) and the measurement compared with the recorded value and the appropriate adjustments made.

In flowing wells where the static water level is above the top of the casing, float-activated recorders cannot be used. If the well can be shut in, however, a pressure recorder can be used.

3.5 Special Procedures for Immiscible Fluids

At those facilities where monitoring to determine the presence or extent of immiscible contaminants is required, the sampler will need to use special procedures for the measurement of fluid levels. The procedures required will depend on whether light immiscibles that form lenses floating on top of the water table or dense immiscibles that sink through the aquifer and form lenses over lower permeability layers are present.

In the case of light immiscibles, measurements of immiscible fluid and water level usually cannot normally be accomplished by using normal techniques. For example, a chalked steel tape measurement will only indicate the depth to the immiscible fluid (not the depth to water) and a conventional electric tape will not generally respond to nonconducting immiscible fluids. Similar problems are found with other techniques.

Procedure: 5619007
Revision: 0
Date: 4/85
Page: 11 of 12

To circumvent these problems, the use of special techniques and equipment can be specified. These techniques have been specially developed to measure fluid levels in wells containing immiscible fluids, particularly petroleum products. One method is similar to the chalked steel tape method. The difference is the use of a special paste or gel rather than ordinary carpenters chalk. Such indicator pastes, when applied to the end of the steel tape and submerged in the well, will show the top of the oil as a wet line and the top of the water as a distinct color change. Another method, similar to the electric tape method, uses a dual purpose probe and indicator system. The probe can detect the presence of any fluid (through the wetting effect) and can also detect fluids that conduct electricity. Thus, if a well is contaminated with low density, nonconducting immiscible fluids such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, electrical conduction will be detected.

Both of these methods have disadvantages. The paste is not very effective with heavier and less refined petroleum products. Also, it can be a cumbersome technique when many wells must be measured owing to tape decontamination between wells. Also, this method cannot be used when sampling for constituents normally found in the paste.

It is important to note that water levels obtained in this situation are not suitable without further interpretation for determining hydraulic gradients. To use those data for determining hydraulic gradients, the differences in density between the light immiscible and water have to be accounted for.

Procedure: 5619007
Revision: 0
Date: 4/85
Page: 12 of 12

Measuring fluid levels in wells screened in lenses of dense immiscibles resting on a low permeability formation is somewhat easier, provided the immiscible fluid is nonconducting. The top of the dense layer can be identified by simply using an electric sounder. As an electric sounder passes from groundwater into the immiscible phase, the detection unit will deactivate because the fluid will no longer conduct electricity. Special pastes or gels may also be available for this purpose. An additional method for determining the interface of a denser-than-water fluid may be appropriate. An hydrometer having a density greater than water but less than the immiscible fluid may be used. Although it is a delicate procedure, the hydrometer should sink through the water but float on the immiscible fluid. Water levels in such wells can be measured by using normal procedures.

4.0 REFERENCES

- USGS. 1984. National Handbook of Recommended Methods for Water-Data Acquisition.
- USGS. 1983. RCRA Permit Writer's Manual: Ground Water Protection (40 CFR Part 264 Subpart F). Geotrans Inc., prepared EPA.

PROCEDURE FOR WELL EVACUATION

1.0 INTRODUCTION

To obtain a representative sample of the groundwater it must be understood that the composition of the water within the well casing and in close proximity to the well is probably not representative of the overall groundwater quality at that sampling site. This is due to the possible presence of drilling contaminants near the well and because important environmental conditions such as the oxidation-reduction potential may differ drastically near the well from the conditions in the surrounding water-bearing materials. For these reasons it is highly desirable that a well be pumped or bailed until the well is thoroughly flushed of standing water and contains fresh water from the aquifer. The recommended amount of purging before sampling is dependent on many factors including the characteristics of the well, the hydrogeological nature of the aquifer, the type of sampling equipment being used, and the parameters being sampled.

A common procedure is to pump or bail the well until a minimum of 2 to 10 bore-volumes have been removed. Two alternative approaches are: (1) monitor the water level in the well while pumping. When the water level has "stabilized" most if not all of the water being pumped is coming from the aquifer; (2) monitor the temperature, conductivity, or pH of the water while pumping. When these parameters "stabilize" it is probable that little or not water from casing storage is being pumped.

The use of an indicating analysis such as pH, temperature, redox potential, or, most commonly, conductivity, may be the most accurate and reliable method of assuring complete well purging. The technique

is easily implemented in the field and gives a rapid and positive indication of changes in the well bore water. This change in the water character and subsequent stabilization can normally be interpreted as evidence that sufficient purging has occurred. It should be noted that the sensitivity of these parameters to changes as a result of exposure of groundwater to surface level conditions (i.e., changes in the partial pressure of dissolved gases or the conditions of the purging system) make in-situ monitoring desirable. An alternative to this would be to conduct these measurements in a closed cell attached to the discharge side of the pump system.

Other factors which will influence the amount of purging required before sampling include the pumping rate and the placement of the pumping equipment within the column of water in the well bore. For example, recent studies have shown that if a pump is lowered immediately to the bottom of a well before pumping, it may take some time for the column of water above it to be exchanged if the transmissivity of the aquifer is high and the well screen is at the bottom of the casing. In such cases the pump will be drawing water primarily from the aquifer.

Purging from just below the water surface insures a more complete removal of the casing water than by withdrawal from well below the surface. When purging does occur from just below the surface, satisfactory results can be obtained at any of a wide range of pumping rates with either a peristaltic or a submersible pump.

Because of the potential for further environmental contamination, planning for purge water disposal is a necessary part of well monitoring. Alternatives range from dumping it on the ground (not back down the well) to full containment, treatment, and disposal. If the well is believed to be contaminated, the best practice is to contain the purge water and store it until the water samples have been

analyzed. Once the contaminants are identified, appropriate treatment requirements can be determined.

2.0 METHODS

There are many methods available for well purging. In some cases bailing will suffice; however, it can become tedious and labor intensive in deep or large diameter wells. Submersible pumps are often the best choice, but most that are readily available to investigators are heavy, awkward and will not fit smaller diameter wells. Models have been on the market for the past few years that will fit inside a 2-inch diameter well; however, they can be costly and not always easy to come by. Gas pressure lift systems are useful in many instances. They are generally light, easy to install, and are useful in many instances. They can be powered by several different pressure systems, usually compressed nitrogen or air. The effect of the contact between the pressure gas and the groundwater usually results in changes in the dissolved gas content. As a result pH, conductivity, or other analysis used to determine purge completion must be conducted down hole. Recent developments in the use of pumps powered by compressed gas have shown promise. Although these too have large gas volume demands when operated at substantial depths, some versions, such as the one built and tested by the NCASI, can also be used for sample collection. Peristaltic pumps are widely used for purging of wells with water levels close to the surface (less than 8 meters). They are reasonably portable, light, and easily adaptable to ground level monitoring of purge indicator parameters by attaching a flow-through cell. These pumps require a minimum of down hole equipment and can easily be cleaned in the field; or the entire tubing assembly can be changed for each well.

3.0 PROCEDURES

3.1 Purging With a Peristaltic Pump

The peristaltic pump can be used for the presample purging of groundwater monitor wells. The use of a peristaltic pump for well purging is particularly advantageous since the same system can later be utilized for sample collection. The application, however, is limited to wells with the capability for peristaltic action.

Procedures for use:

1. Using clean equipment, sound well for total depth and water level, then calculate the fluid volume in the casing ("casing volume").
2. Determine depth from casing top to mid-point of screen, or from casing top to the well section open to the aquifer. (Consult drillers log or sound for bottom.)
3. If depth to mid-point of screen is in excess of 8 meters, choose alternate system.
4. Lower intake into the well to a short distance below the water level and begin water removal. Collect or dispose of purged water in an acceptable manner. Lower suction intake, as required, to maintain submergence.
5. Measure rate of discharge frequently. A bucket and stopwatch are most commonly used.
6. Purge a minimum of two casing volumes or until discharge, pH, temperature, or conductivity stabilize.
7. After pumping, monitor water level recovery. Recovery rate may be useful in determining sample rate.

3.2 Purging With a Gas Pressure Displacement System

A pressure displacement system consists of a chamber equipped with a gas inlet line, a water discharge line and two check valves (see Figure 1). When the chamber is lowered into the casing, water floods it from the bottom through the check valve. Once full, a gas (i.e., nitrogen or air) is forced into the top of the chamber in sufficient amounts to result in the upward displacement of the water out the discharge tube. The check valve in the bottom prevents water from being forced back into the casing and the upper check valve prevents water from flowing back into the chamber when the gas pressure is released. This cycle can be repeated as necessary until purging is complete. The pressure lift system is particularly useful when the well depth is beyond the capability of a peristaltic pump. The water is displaced up the discharge tube by the increased gas pressure above the water level. The potential for increased gas diffusion into the water makes this system unsuitable for sampling for volatile organic or most pH critical parameters.

Procedures for use:

1. Using clean noncontaminating equipment (i.e., an electronic level indicator) determine the water level in the well then calculate the fluid volume in the casing.
2. Determine depth to midpoint of screen or depth to well section open to the aquifer (consult drillers log).
3. Lower displacement chamber until top is just below water level.
4. Attach gas supply line to pressure adjustment valve on cap.
5. Gradually increase gas pressure to maintain discharge flow rate.
6. Measure rate of discharge frequently. A bucket and stopwatch are usually sufficient.

Procedure: 5619008
Revision: 0
Date: 4/85
Page: 6 of 7

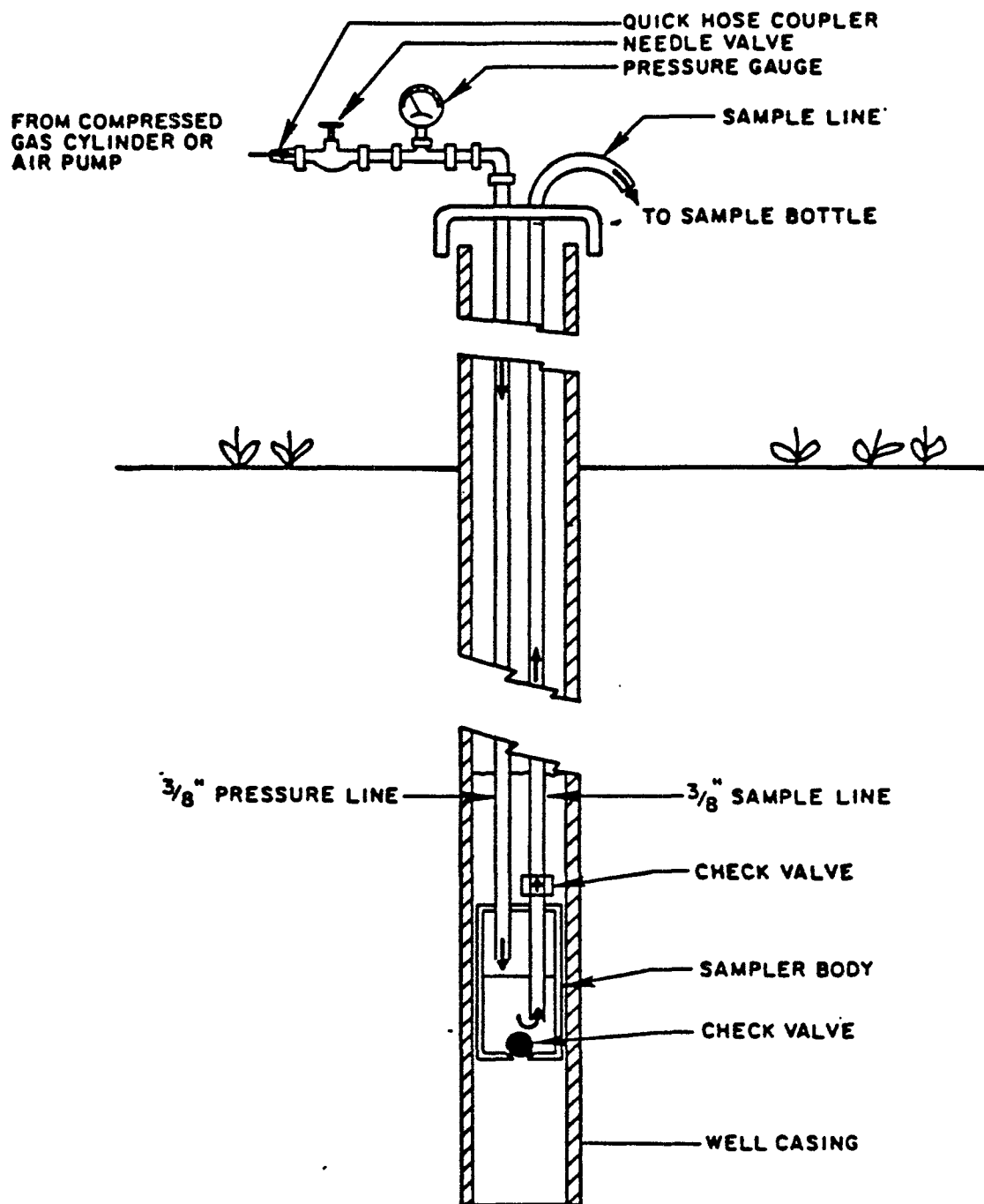


Figure 1 Gas pressure displacement system.

Procedure: 5619008
Revision: 0
Date: 4/85
Page: 7 of 7

7. Purge a minimum of two casing volumes or until discharge characteristics stabilize (see discussion on well purging).
8. After pumping, monitor water level recovery. Recovery rate may be useful in determining sample rate.

4.0 REFERENCES

U.S. Environmental Protection Agency, "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities," EPA-530/SW-611, August 1977.

U.S. Environmental Protection Agency, "Sampling at Hazardous Materials Incidents", EPA Hazardous Response Support Division, Cincinnati, 1984.

CONSIDERATIONS FOR SAMPLE WITHDRAWAL FROM WELLS

1.0 INTRODUCTION

Once the well has been sufficiently purged (procedure 5619008) the actual sampling should begin as soon as the water level begins to approach its pre-purged level. Sampling for volatile organics may begin even sooner, before substantial volatilization begins. If recovery is very slow, it may be necessary to wait several hours or even until the following day before sufficient volume is available for all the necessary analyses. In this instance a volatile organics sample set may be collected soon after completion of the purging process and a second set collected with the remaining samples. When a pump is used for sample collection, its rate should be controlled to closely match the transmissivity of the formation. Excessive draw down of the well during sampling may result in nonrepresentative samples due to changes in groundwater flow.

The major consideration for sample withdrawal is ensuring that the sample is not altered or contaminated during withdrawal from the well. The sampling equipment must use materials compatible with the goals of the particular monitoring program. These materials must neither leach nor adsorb constituents of interest at levels that might be considered significant. Similarly, sampling equipment must be dedicated to individual wells or be capable of being fully disassembled and fully cleaned between sampling events.

Care should be taken to ensure that sampling equipment is lowered into the well with a proper cord. Sampling equipment should be lowered into the well by using single strand (non-plaited) wire of a material that does not conflict with the constituents of interest. Stranded or plaited wire is extremely difficult to decontaminate as pollutants may remain between strands after cleaning and could cause cross

contamination. Plastic-coated wire is often used, except where certain organics are being considered. Teflon-coated wire is the best, although most expensive, choice.

It is also important not to allow the use of methods that allow excessive exposure to the atmosphere or other gases when they might influence the measurement of specific constituents. Exposure of the sample to the atmosphere or other gases may result in changes in the concentration of dissolved gases in the sample. These changes can alter the pH of the sample, which in turn may precipitate the dissolution of specific constituents, particularly metals, and influence water quality measurements. Similarly, changes in the redox potential and, consequently, in the chemical species present may result. Exposure of the sample to the atmosphere or reduced pressures may also result in the degassing and loss of volatile organics from the sample.

When specifying methods for removal of water from monitoring wells, the sampler should examine the proposed methods to ensure that they are suitable both for sample collection and for well evacuation prior to sampling. In general, evacuation methods require greater pumping rates while sample collection methods emphasize to a greater extent the preservation of sample integrity. In many instances, one method will be suitable for both purposes. However, in some cases the use of different methods for well evacuation and sample collection may be appropriate. When examining methods used solely for well evacuation, the sampler should not allow the use of any method that might contaminate or otherwise alter the quality of water remaining in the well. Such an alteration would prevent the subsequent removal of samples representative of ground-water quality.

2.0 SAMPLING STEPS

When sampling a monitoring well, the following procedure should be followed:

1. Check the well for above ground damage.
2. Remove the well cap (a wrench may be needed).
3. Measure and record the depth to water and the time of measurement.
4. Measure the total depth of the well.
5. Remeasure and record the depth of water after a lapse of 4 to 8 minutes following initial measurement and record the depth to water and time of measurement.
6. If successive measurements show essentially no difference, continue the sampling procedure. Where the level change is greater than 1/100th ft, delay the remaining procedures until the change observed and recorded is less than that figure.
7. Determine the amount of water in the well (depth of water x cross sectional area).
8. Clean the sampler as described in the following Section (3.0) immediately prior to inserting it into a well.
9. Collect samples using a bailer, pump, or positive pressure sampler dependent upon the general nature of the contaminants of concern. Sampler materials of construction shall be specifically selected for each contaminant.

3.0 SAMPLER CLEANING

Sampler cleaning is to be performed immediately prior to sampling from any well. Any portion of the sampling device which contacts contaminated water shall be cleaned or disposed of between wells. For example, the cable used for bailing shall be subjected to the same cleaning requirement for a length equal to at least twice the depth to

the water surface. Where pumps are used, short sections of sample tubing may be disposed of rather than cleaned. The following procedure is followed for cleaning samplers and equipment:

- o Rinse with clean tap water.
- o Rinse with reagent grade methanol and allow to air dry.
- o Rinse at east once with clean tap water.

If appropriate the above procedure can be preceded with a wash with soap (Alconox or Liqinox). Line and cables used to lower samplers into monitoring wells will be disposed of in an appropriate manner dictated by the On-site Coordinator or cleaned and rinsed using the procedures outlined above for cleaning sampling devices. Persons obtaining groundwater samples will wear chemically inert protective gloves to prevent skin contact with sampling devices, lines and cables and potentially contaminated groundwater.

4.0 IMMISCIBLE FLUIDS SAMPLE WITHDRAWAL

Recovery of ground water and immiscible fluid samples requires special procedures. Unlike in normal wells, evacuation immediately prior to sampling is not appropriate. Evacuation will normally result in mixing of the two phases, and several days may be required before the two fluids separate and water and immiscible fluid levels stabilize. If evacuation is desired, a few days or possibly a week or more, may be needed for the well to stabilize before sampling.

A sample of the floating immiscible may then be taken by using a bailer that fills from the bottom. Care should be taken to lower the bailer just through the petrochemical layer but not significantly down into the underlying ground water. Samples of the ground water at the bottom of the screen and at some intermediate location, such as the mid-point of the screen, may also be obtained with a bailer. However, in order to avoid mixing the waters, a separate casing can

be temporarily lowered inside the permanent well casing. This casing can be equipped with an easily removed cap on the bottom so that no fluid enters the casing until it has reached the desired depth for sampling. The cap is then knocked free of the bottom of the casing, allowing water entering from that specific depth to be sampled by bailer. At significant depths below the petrochemicals, several full bailers of water may be withdrawn and discarded before the sample is taken to obtain a fresh formation sample. However, it may be impractical to continually knock free caps from the bottom of the insert casing. In some cases, the existing well may no longer be screened in portions of the aquifer containing only water. Consequently, in cases where a large layer of immiscibles develops on top of the water table, it may be best to install a second well screened only in that portion of formation below the lens of floating immiscibles.

Sampling of dense immiscible may be accomplished by using a grab sampler. Pumps with intakes located in immiscible fluid may also be used. If a pump is used, it must be operated at a sufficiently low rate to ensure that no mixing occurs.

5.0 PROCEDURES

A variety of methods are available for sampling and well evacuation, including bailers, suction lift pumps such as the centrifugal and peristaltic pumps, and gas lift methods. Positive displacement or submersible pumps such as centrifugal, piston, gas squeeze, or jet pumps are also available. These methods use differing principles for operation and have distinct and frequently different advantages and disadvantages when applied to sampling and well evacuation. Each is discussed individually below and a summary of their advantages and disadvantages is provided in Table 1. Frequently, several methods will be available that can provide a suitable means for well

TABLE 1 Advantages and Disadvantages of Monitoring Well Sampling Equipment (adopted from Larson (1981a))

Type	Advantages	Disadvantages
A. Baller	Can be constructed in a wide variety of diameters	Time consuming sampling; sometimes impractical to properly evacuate casing before taking actual samples
	Can be constructed from a wide variety of materials	Transfer of water to sample bottle may result in aeration
	No external power source required	
	Extremely portable	
	Low surface area to volume ratio, resulting in a very small amount of outgassing of volatile organics while sample is contained in baller	
	Easy to clean	
	Readily available	
B. Suction lift Pump (Centrifuged, Peristaltic)	Inexpensive	
	Relatively portable	Sampling is limited to situations where water levels are within about 20 ft. from ground surface
	Readily available	
	Inexpensive	Vacuum effect can cause the water to lose some dissolved gas and volatile organics
		In some cases not constructed with materials compatible with sampling certain constituents

Table I (Continued)

Type	Advantages	Disadvantages
C. Gas lift samplers	<p>Relatively portable</p> <p>Readily available</p> <p>Inexpensive</p> <p>Very suitable for well development</p>	<p>Generally not considered appropriate method for acquisition of water samples for detailed chemical studies owing to degassing</p> <p>Regardless of the gas utilized, changes in CO₂ concentrations make this method unsuitable for sampling for pH sensitive parameters</p> <p>Aeration of water remaining in well frequently makes method unsuitable for well evacuation</p> <p>If air is used, oxygenation is impossible to avoid unless elaborate precautions are taken (only a very small amount of oxygen is required to cause a water sample to attain saturation with respect to oxygen)</p>
D. Submersible pumps	<p>Wide range in diameters</p> <p>Various materials are available</p> <p>Fairly portable</p> <p>Depending upon size of pump and pumping depths, relatively large pumping rates are possible</p> <p>Positive displacement minimizes loss of volatiles during pumping</p> <p>Readily available</p>	<p>Conventional units are unable to pump sediment-laden water without incurring damage to the pump</p> <p>Relatively expensive</p>

Table 1 (Continued)

Procedure: 5619C
 Revision: 0
 Date: 4/85
 Page: 8 of 23

Type	Advantages	Disadvantages
E. Gas-Operated squeeze pump (Middelburg type)	<p>Can be constructed in diameters as small as one inch</p> <p>Can be constructed from a wide variety of materials</p> <p>Relatively portable</p> <p>Fair range in pumping rates is possible</p> <p>Driving gas does not contact water sample, eliminating possible contamination or gas stripping</p> <p>Positive displacement minimizes loss of volatiles</p>	<p>Gas source required</p> <p>Large gas volumes and long cycles are necessary for deep operation</p> <p>Pumping rates are not as great as with suction or jet pumps</p> <p>Commercial units are relatively expensive, - pumps cost around \$300.00, while central gas unit cost around \$15.0</p>
F. Gas driven piston pump	<p>Isolates the sample from the operating gas</p> <p>Requires no electrical power source</p> <p>Operates continuously and reliably over extended periods of time</p> <p>Uses compressed gas economically</p> <p>Can be operated at pumping heads in excess of 500 m</p> <p>Positive displacement minimizes loss of volatiles</p>	<p>Relatively expensive; in excess of \$3,000 for the continuously operating unit</p> <p>Particulate material may damage or inactivate pump unless the suction line is filtered</p> <p>Low pumping rates</p>
G. Jet pumps	<p>Capable of producing high yields</p> <p>Commonly used in shallow domestic wells</p> <p>Available for relatively small diameter wells</p>	<p>Requires priming and mixing sample with water circulating in pump, greatly limiting any use in monitor well applications</p> <p>Use of venturi may result in stripping of volatiles</p>

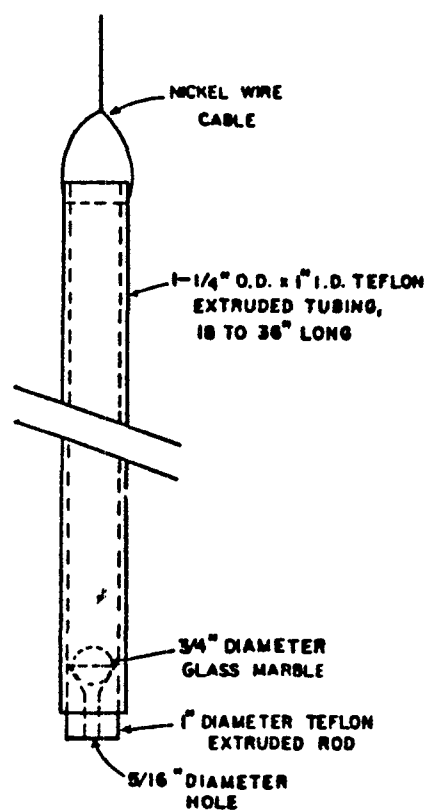


Figure 1 - Teflon Bailer

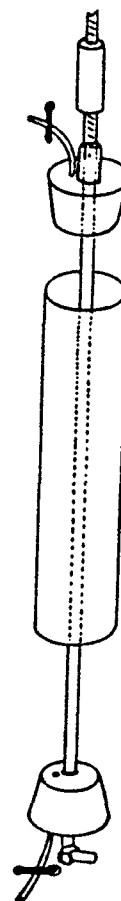


Figure 2 - Modified Kemmerer Sampler

evacuation and sample collection in a particular monitoring program. In such cases, the sampler will want to base the choice of method partly on such factors as monitoring well diameter, water level, pumping volume and rate requirements, accessibility of the site, ease of use, and cost. All of these factors are legitimate and should be considered as long as they do not unduly compromise the goals of the sampling program.

5.1 Bailers

The bailer is one of the oldest and simplest methods available. Bailers consist of a container attached to a cable that is lowered into the well to retrieve a sample. They can be of various designs. The simplest is a weighted bottle or basally capped length of pipe that fills from the top as it is lowered into the well. More sophisticated bailers have a check valve located at the base that allows water to enter from the bottom as it is lowered into the well (see Figure 1). When the bailer is lifted, the check valve closes, allowing water in the bailer to be brought to the surface. More sophisticated bailers are available that remain open at both ends while lowered into the well but can be sealed at both top and bottom by activating a triggering mechanism from the surface. This allows more reliable sampling at discrete depths within a well. Perhaps the best known bailer of this design is the Kemmerer sampler, shown in Figure 2.

Bailers generally provide an excellent means for collecting samples from monitoring wells. They can be constructed from a wide variety of materials compatible with the parameter of interest. Since they are relatively inexpensive, bailers can be easily dedicated to an individual well to minimize cross contamination during sampling. If not dedicated to a well, they can be easily cleaned to prevent cross contamination. Unfortu-

nately, bailers are frequently not suited for well evacuation because of their small volume.

This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, when volatile stripping is of concern, or when well casing diameters are too narrow to accept submersible pumps. It is the method of choice for the collection of samples which are susceptible to volatile component stripping or degradation due to the aeration associated with most other recovery systems. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

The following general procedures should be adhered to for sample withdrawal using a bailer.

1. Lower bailer slowly until it contacts the water surface, then allow it to sink and fill with a minimum of surface disturbance.
2. The cable supporting the sampler should be prevented from coming in contact with the water in the well. The bailer should not come in contact with any materials outside of the well casing. Do not allow the bailer line to contact the ground.

5.2 Suction Pumps

As their name implies, suction pumps operate by creating a partial vacuum in a sampling tube. This allows the pressure exerted by the atmosphere on the water in the well to force water up the tube to the surface. Accordingly, these pumps are located at the surface and require only that a transmission tube be

Procedure: 5619009
Revision: 0
Date: 4/85
Page: 12 of 23

lowered into the well. Unfortunately, their use is limited by their reliance on suction to depths of 20 to 25 ft, depending on the pump. In addition, their use may result in out-gasing of dissolved gases or volatile organics and is therefore limited in many sampling applications. In spite of this, suction methods may provide a suitable means for well evacuation since the water remaining in the well is left reasonably undisturbed.

A variety of pumps are available that operate on this principle, but the most commonly suggested pumps for monitoring purposes are the centrifugal and peristaltic pumps. In the centrifugal pump, the fluid is displaced by the action of an impeller rotating inside the pump chamber. This discharges water by centrifugal force. The resulting pressure drop in the chamber creates a suction and causes water to enter the intake pipe in the well. These pumps can provide substantial yields and are readily available and inexpensive. The disadvantages are that they require an external power source and may be difficult to clean between sampling events. In addition, the materials with which these pumps are constructed may frequently be incompatible with sampling certain constituents. However, their substantial pumping rates make them suitable for well evacuation.

Peristaltic pumps operate in a similar manner to centrifugal pumps but displace the fluid by mechanical peristalsis. A flexible transmission line is mounted around the perimeter of the pump chamber and rotating rollers compress the tubing, forcing fluid movement ahead (the peristaltic effect) and inducing suction behind each roller. This design isolates the sample from the moving parts of the pump and allows for easy cleaning by removal and replacement of the flexible tubing. Unfortunately, peristaltic pumps are generally capable of only providing relatively low yields. They are, therefore, not well suited for

well evacuation in large diameter wells with high yields. However, they may be well suited for well evacuation in small diameter wells with low yields.

In the procedure for peristaltic pumps, ground water is withdrawn through a precleaned 6 mm I.D. teflon tube and discharged into a clean, calibrated one-liter heavy-wall erlenmeyer flask with a peristaltic pump on the outlet side of the sampling flask. Tubing includes 6 mm I.D. teflon, 6 mm I.D. tygon, and 6 mm O.D. glass.

The sampled water only contacts teflon and precleaned glass, and is then carefully transferred to appropriate glass sample containers for shipment to the laboratory. This system shall not be used for samples to be analyzed for volatile organics, because of the possibility of stripping volatile constituents from the sample under the reduced pressure occurring in these systems. It may, however, be used for non-volatile constituents such as metals or other organics.

5.3 Gas Lift Pumps

Gas lift pumps operate by releasing compressed gas through an air pipe inside a larger diameter discharge or eductor pipe. Mixing gas bubbles with the water results in a lower water density inside the discharge pipe, allowing the water to be blown to the surface. Numerous adaptations to the basic method of applying gas pressure to a water well and forcing a water sample out the discharge tube are available for use in monitoring applications. These include the use of a high-pressure hand pump and any reasonably flexible tubing. This provides a highly portable sampling unit. Similarly, a small air compressor or tank of compressed gas and the appropriate piping or flexible tubing can be used. Unfortunately, gas lift methods aerate samples and water

in the well, greatly limiting their suitability for both sample collection and well evacuation.

In general, gas pressure lift systems should not be used for sample collection as they have been shown to cause considerable changes in the groundwater character.

In gas lift pumps, compressed nitrogen is regulated into an approximate 1/2-inch diameter nylon tube connected to the sampler in the well. Groundwater that has permeated the sampler is forced up through an approximate 1/4-inch concentric nylon tube and sampled. The pressure and flow of nitrogen will be controlled with the regulator in order that the groundwater sample exits slowly and with a minimum of "spurting" at the end. One volume of groundwater will be flushed out and discarded to clean the tubes and obtain newly permeated groundwater. All sample bottles will be filled directly from the 1/4-inch tubing.

5.4 Submersible Pumps

A variety of positive displacement pumps are available for use in withdrawing water from wells. These methods use some pumping mechanism placed in the well that forces water from the bottom of the well to the surface by some means of positive displacement. This minimizes the potential for aerating or stripping volatile organics from the sample during removal from the well.

The submersible centrifugal pump is one common example of a positive displacement pump. It works in a manner similar to the centrifugal suction lift pump previously described except that the pump and electric motor are lowered into the well. As the impeller rotates and fluid is brought into the pump, fluid is displaced up the transmission line and out of the well. These

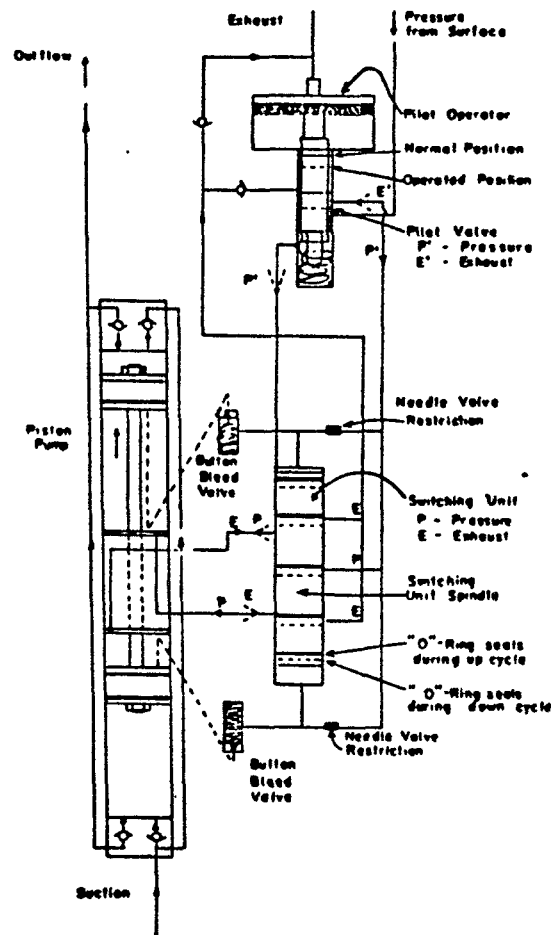
pumps are capable of providing a high yield. However, they require an external source of power and are frequently constructed with materials and contain lubricants incompatible with sampling certain constituents, particularly organics. They require considerable equipment and effort to move from well to well. The chief drawback, however, is the difficulty of avoiding cross contamination between wells. These systems are generally too expensive to allow for several separate units and field decontamination is very difficult. Decontamination should properly require solvents, which may lead to sample contamination. Use of submersible pumps, therefore, in multiple well programs, should be carefully considered against bailers.

5.5 Piston Pumps

Piston-driven or reciprocating piston pumps are another example of common positive displacement pumps (see Figure 3). These pumps consist of a piston in a submerged cylinder operated by a rod connected to the drive mechanism at the surface. A flap valve or ball-check valve is located immediately above or below the piston cylinder. As the piston is lowered in the cylinder, the check valve opens, and water fills the chamber. On the upstroke, the check valve closes, and water is forced out of the cylinder up into the transmission line and to the surface. The transmission line or piston contains a second check valve that closes on the down stroke, preventing water from re-entering the cylinder. These pumps are capable of providing high yields. However, moving these pumps from well to well is difficult, and their use in monitoring programs may require that a pump be dedicated to each well. Many of these pumps are not constructed with materials compatible with monitoring certain constituents.

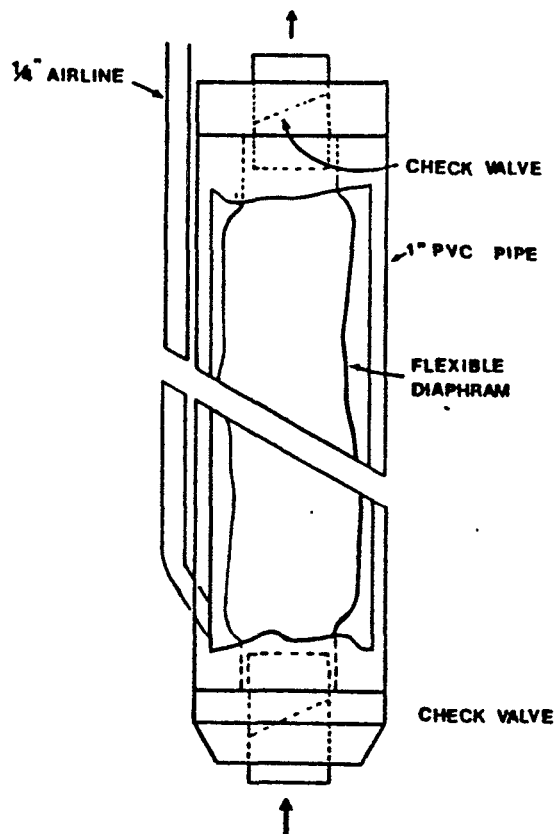
Procedure: 5619009
Revision: 0
Date: 4/85
Page: 16 of 23

Figure 3 - Gas-Driven Piston Pump



Procedure: 5619009
Revision: 0
Date: 4/85
Page: 17 of 23

Figure 4 - Gas-Operated Squeeze Pump



A special adaptation of this pump has recently become available for use in ground-water monitoring. These piston pumps use compressed gas rather than a rod connected to a driving mechanism at the surface to drive the pistons. This provides a much more convenient and portable means for collecting samples from Figures 3/4 monitoring wells. They provide good yields and can be constructed with materials compatible to many sampling programs. This pump is especially useful for sampling water with trace and volatile organic constituents.

5.6 Gas-Operated Squeeze Pumps

Another positive displacement pump applicable for monitoring purposes is the gas-operated squeeze pump (see Figure 4). This pump was originally developed by R. F. Middelburg of the U.S. Geological Survey and consequently is referred to as the Middelburg pump. It consists principally of a collapsible membrane inside a long rigid housing, a compressed gas supply, and appropriate control valves. When the pump is submerged, water enters the collapsible membrane through the bottom check valve. After the membrane has filled, gas pressure is applied to the annular space between the rigid housing and membrane, forcing the water upward through a sampling tube. When the pressure is released, the top check valve prevents the sample from flowing back down the discharge line, and water from the well again enters the pump through the bottom check valve.

Gas-operated squeeze pumps offer a number of advantages for use in groundwater monitoring programs. They can be constructed in diameters as small as 1-in. and from a wide variety of materials. They are also relatively portable and are capable of providing a fair range of pumping rates. Most important, the driving gas

does not contact the water sample, thus eliminating possible contamination or gas stripping. However, they do require a gas source, and withdrawal of water from substantial depths may require large gas volumes and long pumping cycles.

5.7 Jet Pumps

Jet pumps are a common submersible pump used in small domestic water wells and may in some cases be suggested for use in monitoring wells. These pumps operate by injecting water through a pipe down into the well. A venturi device is located at the intake portion of the pump. As the water injected from the surface passes through the constricted portion of the venturi, the velocity increases and pressure decreases according to Bernoulli's principle. If the discharge velocity at the nozzle is great enough, the pressure at this point will be lowered sufficiently to allow water to be drawn into the venturi assembly through the intake and brought to the surface with the original water injected into the well. This additional increment of water is then made available at the surface as the pump's output. Jet pumps generally require priming with water, and the water taken from the well mixes with water circulating in the system. A simple modification can be added to this design to circulate a portion of the pumped water back through the system, eventually reducing the concentration of primary water effectively to zero. This type pump is not suitable for sampling water for volatile organics since the turbulence produced by the venturi system will strip volatiles from the water.

6.0 CHOOSING THE BEST METHOD

Since the nature of the pollutant or parameter being monitored is the primary factor for specifying well evacuation and sampling methods,

evaluation of any proposed method is most conveniently based on the general class of pollutant or parameter that requires monitoring in a particular program. For this purpose, pollutants and monitoring parameters can be categorized into the following classes: physical properties, metals, nonmetallic inorganics, general organic parameters and organics.

6.1 Physical Properties

Physical properties include such parameters as conductance, color, pH, temperature, and turbidity. In general, most sampling methods are acceptable for these parameters, provided they allow a thorough rinsing between sampling events. However, methods that affect gas composition of the sample will affect pH. Consequently, the sampler should not use gas lift methods for sampling when pH is a parameter of interest. Since gas lift methods may also leave water in the well in a disturbed and aerated condition, these methods are not suitable for well evacuation when pH is a parameter of interest.

6.2 Metals

Similarly, since concentration of metals can be significantly influenced by changes in pH, sampling for metals should not be allowed with gas lift or suction methods. The guidance provided above for well evacuation when pH is the parameter of interest also applies for metals. In addition, equipment used for monitoring metal concentrations should be metal free. Consequently, bailers and positive displacement pumps are most suitable for sampling metals, provided they are constructed of appropriate materials. The methods acceptable for well

evacuation are less restricted, but gas lift methods or equipment that alters the metal concentration of water remaining in the well through leaching or absorption should be avoided.

6.3 Inorganic, Nonmetallic Constituents

Inorganic, nonmetallic constituents or parameters include acidity, alkalinity, bromide, chloride, fluoride, nitrogen, etc. Most of the sampling and well evacuation methods described above are generally acceptable when considering the inorganic, nonmetallic parameters. However, for parameters affected by pH or dissolved gas changes, such as alkalinity, methods that minimize changes in dissolved gas composition are recommended for sampling. These methods include bailers, squeeze pumps, and piston pumps; gas lift techniques are not recommended for well evacuation.

6.4 Organics

Generalized organic parameters include parameters such as oil and grease, COD, TOC, and TOX. Most sampling and well evacuation methods are suitable for these parameters, with the exception of the more sensitive parameters such as TOX. These sensitive parameters require methods suitable for sampling volatile organic.

It has generally been recommended that sampling for volatile organics be done with a glass or Teflon bailer after flushing with a nonaerating pump. However, positive displacement pumps may also be acceptable in sampling, provided they are constructed with suitable materials (Teflon, glass, or stainless steel in most cases).

7.0 EXISTING IN-PLACE PUMPS

Occasionally ground water samples are obtained using wells which have existing in-place pumps. This limits the precautions the sampler can take to ensure a non-contaminated sample. Samples should be obtained from outlets as close as possible to the pump and should not be collected from leaky or faulty spigots or spigots that contain screens or aeration devices. The pump should be run for 5 - 10 minutes before the sample is collected, and the waste-water properly disposal of. A steady-flowing water stream at moderate pressure is desirable in order to prevent splashing and dislodging particles in the faucet or water line.

To collect the sample, remove the cap or stopper carefully from the sample bottle. Do not lay the bottle closure down or touch the inside of the closure. Avoid touching the inside of the bottle with your hands or the spigot. The sample bottle should not be rinsed out and it is not necessary to flame the spigot. The bottle should be filled directly to the top. The bottle closure and closure-covering should be replaced carefully and the bottle should be placed in a cooler (4 - 10°C) unless the sample is going to be processed immediately in the field.

8.0 SAMPLING FROM NATURAL SPRINGS

For springs in unconsolidated deposits, drive a well point or a slotted pipe one meter or less into the ground adjacent to the spring. Collect from the artesian flow or use a pump. Use plastic pipe and plastic well screens for trace metal determinations. To sample larger upwelling springs, attach the pump intake to a pole and submerge it in the mouth of the spring.

Procedure: 5619009
Revision: 0
Date: 4/85
Page: 23 of 23

9.0 REFERENCES

- Geotrans, Inc., 1983. RCRA Permit Writer's Manual: Ground-Water Protection (40 CFR Part 264 Subpart F). U.S.E.P.A. contract no. 68-01-6464.
- U.S.G.S., 1984 (revised), National Handbook of Recommended Methods for Water-Data Acquisition.
- U.S. EPA, Hazardous Response Support Division, 1984. Sampling at Hazardous Materials Incidents.
- Scalf, M.R., McNobb, J.R., Dunlap, W.J., Cosby, R.L., Fryberzer, R., 1981. Manual of Ground-Water Sampling Procedures. NWWA/EPA Series.

SURFACE WATER SAMPLING GUIDELINES

1.0 OBJECTIVE

The objective of obtaining surface water samples is to determine the surface water quality entering, leaving or affected by the site. Surface water samples are considered environmental samples (containing low concentrations of contaminants) but accurately quantifying the contaminants present is of utmost importance. In order to obtain a representative sample, the hydraulics of the water course must be determined before sampling, so that the most representative sample can be obtained.

Either grab or composite samples may be collected. Grab samples are collected at one particular point, and time. Flow- or time-weighted composite samples are composed of more than one aliquot collected at various sampling sites and/or at different times. Because of the unknown safety risks, as well as the changes in chemical nature of the sample that may occur through compositing, samples containing hazardous materials at significant concentrations shall not be composited. Environmental samples containing low levels of toxics may be composited.

If it is necessary to wade into the water course to obtain a sample, the team member shall be careful not to disturb bottom sediments and shall enter the water course downstream of the sampling location. While in reality, it is difficult to prevent disturbance of the sediments, it is the responsibility of the team member to minimize the introduction of sediments into the sample. If necessary, the sampling technician shall wait for the sediments to settle before taking the sample.

If the water course is moving, a depth integrated grab sample shall be obtained. A depth integrated sample is collected by lowering an open container against the flow, to a depth just above bottom. The container is then turned into the flow and raised at a rate that allows it to just fill when it reaches the surface. The sample shall be collected in the middle of the stream.

2.0 EQUIPMENT

The best choice of sampling equipment depends on the particular conditions at the site and the water body being sampled. The types of samplers available are:

- o Open tube
- o Pond Sampler
- o Manual Hand Pump
- o Weighted Bottle Sampler
- o Kemmerer Sampler
- o Extended Bottle Sampler.

Of these, the pond sampler and the weighted bottle sampler will be used most often. The criteria for selecting a sample collector are:

- o Disposable and/or easily decontaminated - A collection device may not be used again without sufficient cleaning.
- o Inexpensive - This is a necessity if the item is to be disposed of.
- o Ease of operation - Cumbersome safety clothing and the use of protective respiratory equipment dictate the use of simple tools.
- o Nonreactive - The device must not react with the sample in such a manner as to contaminate it.
- o Safe - The unit must not present a safety threat to the user.

3.0 SAMPLING METHODS

3.1 Pond Sampler

The pond or dip sampler (Figure 1) consists of a container attached to the end of a long pole by an adjustable clamp. The pole can be of any non-reactive material such as wood, plastic or metal, as it will not be in contact with the sample itself. The sample shall be collected in a jar or beaker made of stainless steel, glass or non-reactive plastic. Preferably, a disposable beaker which can be replaced, shall be used at each station. Liquid wastes from water courses, ponds, pits, lagoons or open vessels are "ladled" into a sample container.

3.2 Manual Hand Pumps

Manual pumps are available in various sizes and configurations. Manual hand pumps are commonly operated by peristaltic, bellows or diaphragm, and siphon action. Manual hand pumps which operate by a bellows or diaphragm, and siphon action should not be used to collect samples which will be analyzed for volatile organics.

The pump is operated according to manufacturer's instructions. The sample inlet hose is inserted into the liquid to be sampled, and a crank or bellows is activated.

To avoid contamination of the pump, a liquid trap consisting of a vacuum flask is inserted at the sample inlet hose to collect the sample (Figure 2). Teflon tubing shall be used for the inlet hose in order to avoid sample contamination. The hose and trap must be flushed between stations with a minimum of three volumes of liquid, and cleaned or replaced at the end of each day.

Procedure: 5620001
Revision: 0
Date: 4/85
Page: 4 of 7

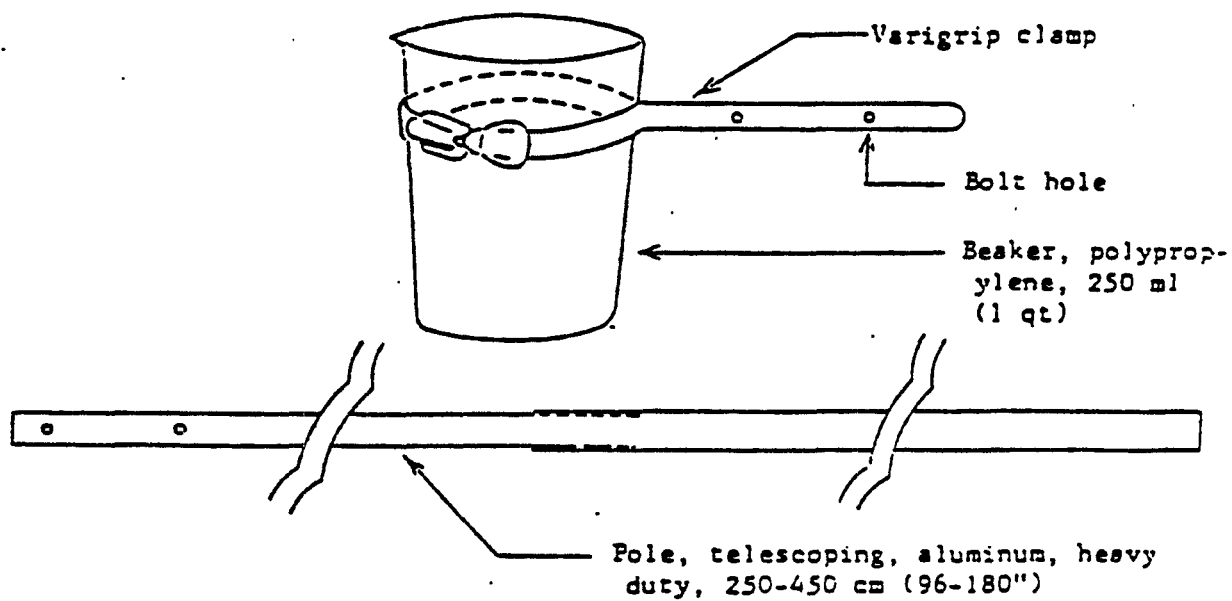


Figure 1 Pond sampler

Procedure: 5620001
Revision: 0
Date: 4/85
Page: 5 of 7

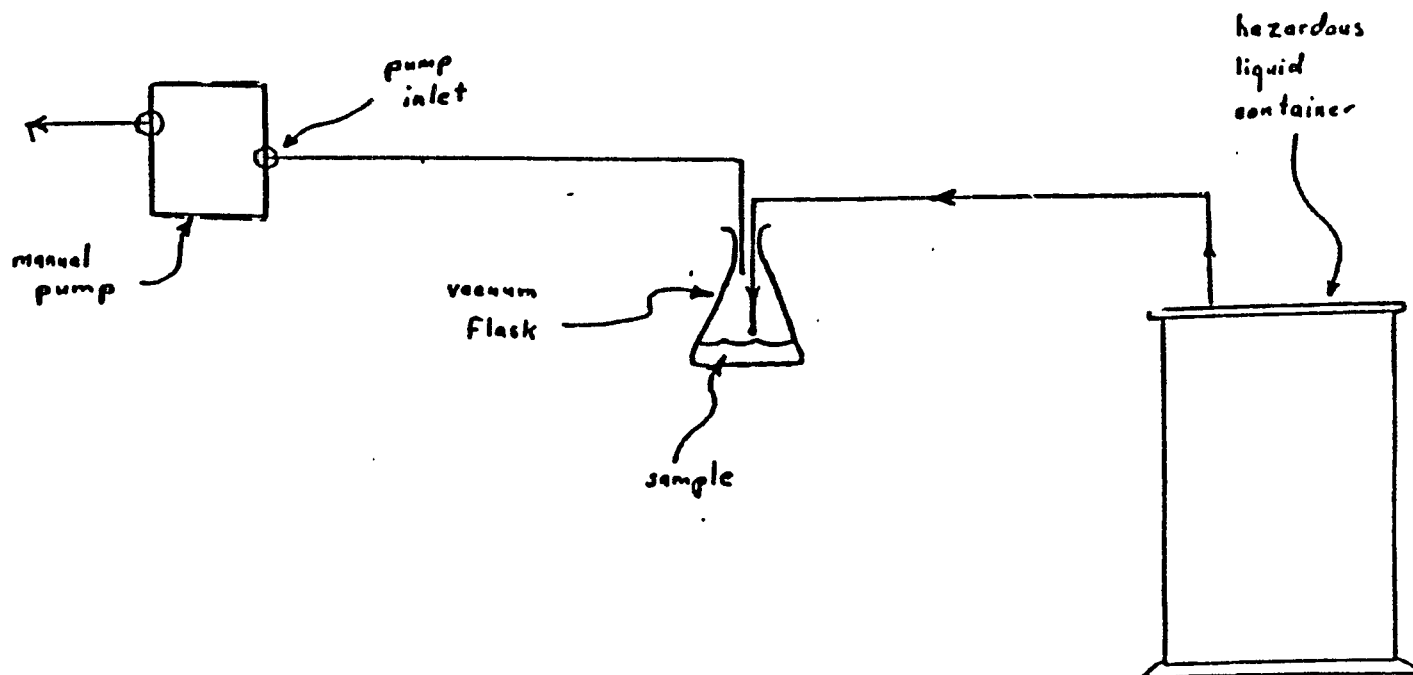


Figure 2

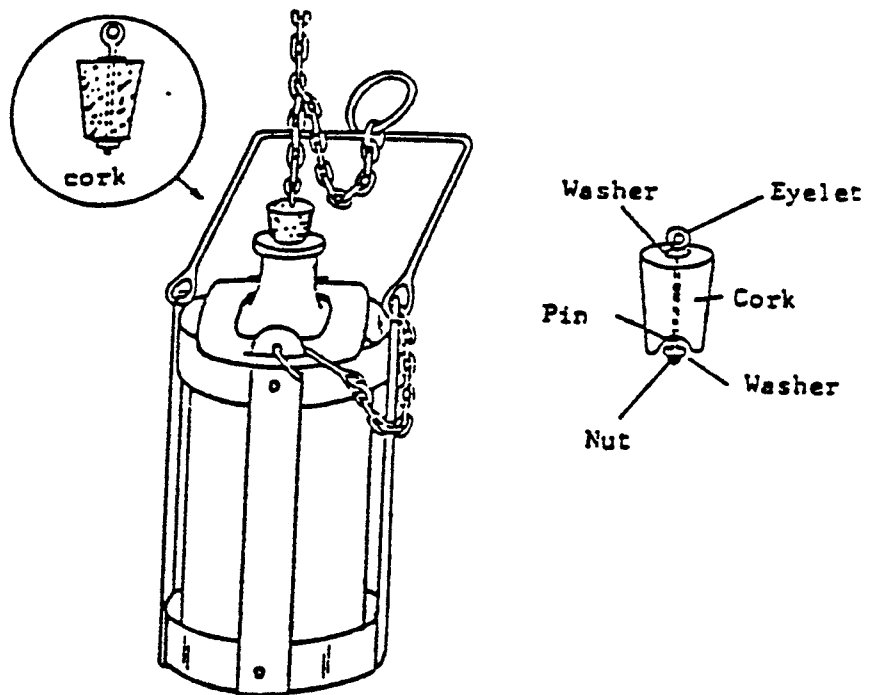
3.3 Weighted Bottle Sampler

The sampler (Figure 3) consists of a glass bottle, a weight sinker, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling. There are variations of this sampler, as illustrated in the ASTM methods D 270 and E 300. This sampler can be either fabricated or purchased. Procedure for use:

1. Assemble the weighted bottle sampler as shown in Figure 3.
2. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely.
3. Pull out the stopper with a sharp jerk of the sampler line.
4. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
5. Raise the sampler and cap the bottle.
6. Wipe the bottle clean. The bottle can be used as the sample container.

Alternatives to the weighted bottle sampler are the Kemmerer sampler and the extended bottle sampler.

Procedure: 5620001
Revision: 0
Date: 4/85
Page: 7 of 7



1000-ml (1-quart) weighted
bottle catcher

Figure 3 Weighted bottle sampler.

PROCEDURE FOR USE AND MAINTENANCE OF FIELD NOTEBOOKS

1.0 INTRODUCTION

Field notebooks provide means for recording all data collecting activities performed at a site. As such, entries should be as descriptive and detailed as possible, so that a particular situation could be reconstructed without reliance on the collector's memory.

2.0 NOTEBOOK USE

Field notebooks shall be bound, 4 x 7 to 8 x 10.5 inch books with consecutively numbered pages. Notebooks shall be permanently assigned to field personnel, but are to be stored in site project files when not in use. Each notebook is identified by a document control number which indicates:

ZJX - FN - XXXX - XX

(Site Number - Field Notebook - Owner Identification - Sequence Number)

The cover of each notebook contains the following information:

- o Person or Organization to whom the book is assigned
- o Book Number
- o Site Name and Number
- o Start Date
- o End Date

Entries into the logbook may contain a variety of information. At the beginning of each entry the following information is recorded; the

date, start time, weather, all field personnel present, level of personal protection being used on-site, and the signature of the person making the entry should be noted.

All measurements made and samples collected are recorded. All entries should be made in pen. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialled. Entries should be organized into easily understandable tables if possible. A sample format is shown in Exhibit 1.

At each station where a sample is collected or a measurement made, a detailed description of the location of the station, which includes compass and rangefinder measurements, are recorded. The film roll number and number of photographs taken at the station are also noted.

All equipment used to make measurements is identified, including the date on which the equipment was calibrated.

Samples are to be collected following sampling procedures described in this manual. The equipment used to collect samples should be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. In addition, the identification of the container number into which the sample is placed in the field is recorded. Sample numbers are assigned prior to going on-site. Duplicates, which receive an entirely separate sample number, are noted under sample description. Significant field notebook entries (samples collected, significant observations) must be countersigned by another member of the project team.

Procedure: 5621004
Revision: 0
Date: 3/85
Page: 3 of 4

EXHIBIT 1
TYPICAL FIELD NOTEBOOK ENTRY FORMAT

START TIME

DATE

WEATHER: _____

FIELD PERSONNEL: _____

LEVEL OF PERSONAL PROTECTION: _____

RECORDER'S SIGNATURE: _____

EQUIPMENT (NAME/CONTROL NO.): _____

CALIBRATION DATE: _____

Station No./Location Description: _____

Film Roll Number: _____ Photograph Numbers: _____

Station No.	Parameter (Units)
_____	_____
_____	_____
_____	_____

Procedure: 5621004
Revision: 0
Date: 3/85
Page: 4 of 4

Typical Field Notebook Entry Format (Cont.)

Date
Start Time

Sampling Equipment: _____

<u>No.</u>	<u>Time</u>	<u>Sample Description</u>	<u>Depth</u>	<u>Number</u>	<u>Volume</u>	<u>Chest No.</u>	<u>Comments</u>

SAMPLE CLASSIFICATION, HANDLING AND SHIPMENT

1.0 INTRODUCTION

The protocols for the classification, handling, and shipment of samples collected on and adjacent to uncontrolled hazardous waste sites are presented in this procedure. Steps in the procedure should be followed to ensure the integrity of the samples, as well as protecting the welfare of the persons involved in the shipment, the shipper, and receiver of the samples. When sent by common carrier, the packaging, labeling and shipping of hazardous wastes and substances is regulated by the U.S. Department of Transportation (DOT; 49 CFR).

2.0 SAMPLE CLASSIFICATION

Samples obtained at uncontrolled hazardous waste sites are classified as either environmental samples or hazardous samples. Environmental samples are those which contain low levels of contaminants and require implementation of limited precautionary procedures. Hazardous samples are those which could possibly contain dangerous levels of contaminants. Hazardous samples must be packaged and labeled according to procedures specified by the U.S. DOT, or the state DOT, whichever is more stringent.

2.1 Environmental Samples

Environmental samples are those samples known not to contain dangerously high levels of contaminants. If any doubt exists as to the extent of contamination, samples should be treated as hazardous.

Procedure: 5622001
Revision: 0
Date: 3/85
Page: 2 of 8

Environmental samples are collected in an appropriate container allowing approximately 10 percent air space (ullage) so that the container is not full at 130° F. If a head space is not desired for a particular analysis (i.e., volatile organic analyses), the container should be placed inside another container, to provide the desired head space. The sealed and labeled container is then placed inside a ziplock polyethylene bag which is also sealed. The sealed package is then placed inside a shipping container, packed so as to prevent breakage. No precautionary notices are required on the package exterior.

2.2 Hazardous Samples

Samples not designated as environmental samples or which are known to contain hazardous materials must be considered hazardous. DOT has established a prioritized system of transportation categories which depends on the degree of hazardousness of the material. The relevant portion of this listing is shown in Table 1.

Initially, all samples should be surveyed for radiation. If radiation levels are below 0.5 millirems per hour at the surface of the package material, the sample is not shipped as radioactive. If the radiation level exceeds 0.5 millirems per hour, the sample is shipped as radioactive. The Code of Federal Regulations Title 49, sub part I, should be consulted to provide proper shipping containment for shipping of a radioactive sample.

Poison "A" is the next category on the DOT list. Poison "A" substances (listed in Table 2) are defined by DOT as extremely dangerous poisonous gases or liquids of such toxicity that a very small amount of gas, or vapor of the liquid, mixed with air is life threatening. Many of the Poison "A" materials are gases or

TABLE 1 DOT HAZARDOUS MATERIALS CLASSIFICATION

1. Radioactive Material	12. Combustible liquid (in containers having capacity exceeding 110 gallons)
2. Poison "A"	13. ORM-B
3. Flammable Gas	14. ORM-A
4. Non-flammable gas	15. Combustible liquid (in containers having capacity of 110 gallons or less)
5. Flammable liquid	16. ORM-E
6. Oxidizer	
7. Flammable Solid	
8. Corrosive Material (liquid)	
9. Poison B	
10. Corrosive Material (solid)	
11. Irritating Materials	

TABLE 2 CLASS "A" POISONS AND THEIR PHYSICAL STATE AT ROOM TEMPERATURES

<u>Compound</u>	<u>Physical State</u>
arsine	gas
bromoacetone	liquid
chloropicrin & methyl chloride mixture	gas
chloropicrin & non-flammable, non-liquified compressed gas mixture	gas
cyanogen chloride	gas at temperature greater than 13.1 degrees C
cyanogen gas	gas
gas identification set	
gelatin dynamite (H.E. Germaine)	-
grenade (with poison "A" gas charge)	-
hexaethyl tetraphosphate & compressed gas mixture	gas
hydrocyanic acid (prussic) solution)	liquid
hydrocyanic acid, liquified	gas
insecticide liquified gas, containing poison "A" or poison "B" material	gas
methyldichloroarsine	liquid
nitric oxide	gas
nitrogen peroxide	gas
nitrogen tetroxide	gas
nitrogen dioxide, liquid	gas
parathion & compressed gas mixture	gas
phosgene (diphosgene)	liquid

Procedure: 5622001
Revision: 0
Date: 3/85
Page: 4 of 8

compressed gases and would not be found in drum type containers. Liquid poison "A"'s would probably be found in closed containers which provides a "worst case" situation. Not all samples found in drums should be labeled Poison "A". Based upon the information available, a judgement must be made as to the hazard class of the sample. If the sample is suspected or determined to fall within the Poison "A" classification, packaging procedures specified by DOT should be followed as specified in 49 CFR, Part 173.326-328.

The next two classifications in the DOT series are "flammable" or "non-flammable" gases. Few, if any, gas samples are expected to be collected at uncontrolled hazardous waste sites. Use this category only when shipping containerized gases or gas samples.

The next category to be considered is "flammable liquids". Hazardous samples in liquid form, unless known to fall into a lower category, will be handled, packaged and shipped at this level of concern. However, lesser categories will generally not be considered because flashpoint testing required to drop to a lower level is difficult and possibly dangerous in the field. It is more practical to handle samples at the "flammable" level than to undertake field determination of the flash point.

Solids samples known or suspected to be flammable are shipped as flammable solids. Non-flammable solids may be shipped as Poison "B", corrosive, or irritant materials based on characteristics of the sample and DOT regulations.

Small quantities (i.e., less than 5 pounds of a solid and one pint of liquid in a single package) of hazardous waste samples can be shipped under the Other Regulated Material (ORM) category. If the material is known, the ORM-A or ORM-B classification may be used. 49 CFR 173 parts K and L list the ORM A and ORM B

Materials. If the material is unknown or not listed under parts K and L, the ORM-E category may be used. The ORM-E category is for hazardous waste liquids and solids, not otherwise specified.

The following steps apply to handling flammable liquid and solid samples.

3.0 SAMPLE PACKAGING

Samples are collected in glass containers with non-metallic, teflon-lined screw caps. Sufficient ullage (approximately 10 percent by volume) is allowed so that the container is not liquid-full at 130 degrees Fahrenheit. If an air space in the inner most container cannot be tolerated in order to maintain sample integrity, the sample shall be placed within a second container to provide the required air space.

In collecting a solid material, the container plus contents shall not exceed 1 pound net weight. Large quantities of material, up to 1 gallon, may be collected if the flash point of the sample can be determined to be 73 degrees Fahrenheit or higher. If this is the case, this information should be marked on the outside container (carton, etc.), but only a single (1 gallon or less) bottle may be packed in an outside container with 10 percent air space. The shipping papers are required to state that the "flash point" is 73 degrees or higher.

Seal the sample container and place each in a separate 2-mil thick (or thicker) ziplock polyethylene bag. The sample identification tag should be positioned to enable it to be read through the bag.

Each sealed bag shall be placed inside an appropriate sized metal can or other DOT approved container with enough noncombustible, absorbent,

Procedure: 5622001
Revision: 0
Date: 3/85
Page: 6 of 8

cushioning material (e.g., bentonite, vermiculite or diatomaceous earth) to prevent breakage and provide for absorption of liquid; one bag per can. Pressure close the can and use clips, tape or other positive means to hold the lid securely, tightly, and effectively.

The metal cans or other DOT-approved container, or a single 1-gallon bottle shall be placed into a strong outside container, such as a metal picnic cooler or an approved fiberboard box and surrounded with noncombustible, absorbing packaging material for stability during transport.

4.0 MARKING AND LABELING

Abbreviations are used only where specified by DOT. The following information shall be placed on each metal can, other DOT-approved container, or 1-gallon bottle. Appropriate labels are supplied by the Regional Equipment Manager.

The label should contain the laboratory name and address and appropriate DOT hazardous shipment category. As a conservative approach "Flammable Liquid N.O.S. UN1922" can be used for most liquids and "Flammable Solid N.O.S. UN1325" for most solids. If you know for certain that the sample is not a flammable liquid or solid, then another category in the DOT hierarchy should be used. Not other specified (N.O.S.) is used when the sample is not identified. Identify the sample by name and UN identifier when known.

The following DOT labels shall be placed on the outside of the can (or bottle), depending on contents.

"Cargo Aircraft Only" (Danger Peligro) - "Flammable Liquid",
"Flammable Solid", "Dangerous When Wet" or "Corrosive".

Procedure: 5622001
Revision: 0
Date: 3/85
Page: 7 of 8

If the cans are placed in an exterior container, both the container and inside can (or bottle) must have the same markings and labels as above.

"LABORATORY SAMPLES" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top and/or front side of the outside container, and upward pointing arrows should be placed on all 4 sides of the exterior container.

5.0 SHIPPING PAPERS

Abbreviations shall be used only where specified below. The bill of lading supplied by the carrier should be completed and the certification statement signed (if not provided by the carrier, standard industry form shall be used) with the following information in the order listed. One form may be used for more than one exterior container.

"Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325", "Cargo Aircraft Only", "Limited Quantity" or "Ltd. Qty.", "Laboratory Samples", "Net Weight _____" or "Net Volume _____" of hazardous contents, by item, if more than one metal can is inside of exterior container.

The net weight or net volume must be placed just before or just after the "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." description.

A complete chain-of-custody record, enclosed in an envelope is included in the sample container.

Containers must be ~~loaded or otherwise sealed~~ *securely sealed with strapping tape or similar closing media and a chain-of-custody seal affixed to the opening plane of the outer container*

Procedure: 5622001
Revision: 0
Date: 3/85
Page: 8 of 8

6.0 TRANSPORTATION

All samples should be shipped by Federal Express. "Cargo Only" aircraft may be used, but hazardous samples shall not be transported by any carrier which also carries passengers.

Hazardous or environmental samples may be transported by CDM personnel in private vehicles.

SAMPLE IDENTIFICATION PROCEDURE

1.0 INTRODUCTION

A coding system will be used to identify each sample taken during the sampling program. This coding system will provide a tracking record to allow retrieval of information about a particular sample and assure that each sample is uniquely identified.

2.0 SAMPLE IDENTIFICATION

Each sample is identified by a unique code which indicates the site number, sample type, sample point, and sequence number. An example of the sample identification code will be as follows:

150-SW-010-003

Where 150 indicates the site number, SW the sample type, 010 the sample point, and 003 the sequence number.

A three digit number will be used to identify each site. The site number will be obtained from the National Project Management Office and be used as an identifier for all samples collected at that site.

A two letter designation is used to identify the specific type of sample being taken followed by three digits which indicate the station location. The sample types which will be collected during the remedial site investigations are:

SW - Surface water grab sample (streams, rivers, lakes, runoff)

SF - Surface water flow (continous measurement)

Procedure: 5622002
Revision: 0
Date: 3/85
Page: 2 of 3

GW - Ground water sampled from various types of wells

WQ - Continuous water quality measurement

SL - Soil samples (beds, surface soil, surface borings)

SS - Subsurface samples (drill core, split spoon, etc.)

SD - Sediment samples collected from stream beds, lagoons, etc.

LG - Lagoon samples

TS - Tank samples including above ground and below ground
enclosures

DM - Drum samples

AM - Meteorological station

AG - Gaseous air samples

AP - Particulate air samples

AO - Organic air samples

MS - Trace metal samples

RS - Rock samples

BI - Biological samples

A three digit number will be used to identify a sample point location.
This location can be a soil sample point, bore hole, well, drum, tank

Procedure: 5622002
Revision: 0
Date: 3/85
Page: 3 of 3

surface water sample point, lagoon point, air monitor station, or any other point where a source material, water, soil, core, or air sample may be taken.

The final sample identification code will be a sequence identifier. This number will be used to identify separate samples collected at the same sample point.

The sample type, sample point identifier and sequence number codes should be established for each sample to be collected prior to field activities. This step can be performed manually or through the use of computer programs.

CHAIN-OF-CUSTODY

1.0 INTRODUCTION

Chain-of-Custody procedures provide documentation of the handling of each sample from the time it is collected until it is destroyed. Such a written record is especially important if the results of analyses of samples will be used to support litigation.

2.0 CHAIN-OF-CUSTODY PROTOCOLS

To maintain a record of (1) sample collection, (2) transfer of sample between personnel, (3) sample shipment, and (4) receipt by the laboratory which will analyze the sample (which will then continue the chain-of-custody within their laboratory records), a "Chain-of-Custody Record" is filled out for each sample type at each sampling location. Form F6260, or a resonable facsimile, will be used on the REM II program. Each time the samples are transferred to another custodian, signatures of the person relinquishing the sample and receiving the sample, as well as the time and date, should document the transfer. As stated in Procedure 5622004 each sample container will be labeled with a pressure sensitive gummed label. The label contains the sample number, date and time of sample collection, location of sample collection, depth of sample collection, preservatives used and the names of collector(s) and initial(s).

The chain-of-custody form (F6260) will include four pressure sensitive copies so that four forms are filled out simultaneously. The On-site Coordinator retains the original and any extra copies, and additional copies are shipped with the samples until they are received by the laboratory(ies). If samples are split to different labs, a copy will go to each lab. Care must be taken that all four copies are legible. If additional duplicate sheets are required, the person relinquishing the samples is responsible for filling out additional copies, or making reproductions. The original must be returned by the On-site Coordinator to the site project files.

Procedure: 5622005
Revision: 0
Date: 3/85
Page: 2 of 2

The Chain-of-Custody Record will be placed in a ziplock bag and placed inside of all shipping and transport containers. All samples will be shipped by Federal Express to the laboratory specified in the project operations plan. Samples should be packed so that no breakage will occur. The shipping or external container should be sealed with evidence tape and initialled so that any sign of tampering is easily visible.

SAMPLE BOTTLE PREPARATION, SAMPLE PRESERVATION AND MAXIMUM HOLD TIMES

1.0 INTRODUCTION

Complete and unequivocal preservation of samples, either domestic sewage, industrial wastes, or natural waters, is a practical impossibility. Regardless of the nature of the sample, complete stability for every constituent is not likely to be achieved. At best, preservation techniques can retard the chemical and biological changes that inevitably continue after the sample is removed from the parent source. Degradation of the sample ceass only if it is preserved at a temperature of absolute zero (-273°C). Therefore, as a general rule, it is best to analyze the samples as soon as possible after collection. This is especially true when the analyte concentration is expected to be in the low ug/l range.

Methods of preservation are relatively limited and are intended generally to (1) retard biological action, (2) retard hydrolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

The recommended preservative for various constituents is given in Table 1. Preservation techniques for samples requiring more than simple refrigeration or filtering are discussed in section 3.0. Other information provided in the table is an estimation of the volume of sample requirred for the analysis, the suggested type of container, and the maximum recommended holding times for samples properly preserved.

To minimize changes in the chemical quality of a sample during shipping and storage prior to analysis, the sampler should use proper containers and adequate procedures for sample preservation and

Parameter No./name	Container ¹	Preservation ^{2,3}	Maximum holding time ⁴
Soil			
all and total	P, G	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	6 hours.
.....	P, G	.....do	Do.
Water			
at Tests:	P, G	Cool, 4°C	14 days.
.....	P, G	.....do	Do.
.....	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
.....	P, G	Cool, 4°C	48 hours.
.....	P, G	None required	28 days.
.....	P, G	Cool, 4°C	48 hours.
.....	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
.....	P, G	None required	Do.
.....	P, G	Cool, 4°C	Analyze immediately.
.....	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid ⁶	48 hours.
.....	P	None required	14 days. ⁹
.....	P, G	HNO ₃ to pH<2, H ₂ SO ₄ to pH<2	28 days.
.....	P, G	None required	6 months.
.....	P, G	None required	Analyze immediately.
.....	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
Metals:⁷			
18. Chromium VI	P, G	Cool, 4°C	24 hours.
26. Mercury	P, G	HNO ₃ to pH<2	28 days.
3, 5-8, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75. Metals, except chromium VI and mercury.	P, G	.....do	6 months.
38. Nitrate	P, G	Cool, 4°C	48 hours.
39. Nitrate-nitrite	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
40. Nitrite	P, G	Cool, 4°C	48 hours.
41. Oil and grease	G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
42. Organic carbon	P, G	Cool, 4°C, HCl or H ₂ SO ₄ to pH<2	Do.
44. Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours.
46. Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately.
47. Winkler	.....do	Fix on site and store in dark	8 hours.
48. Phenols	G only	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
49. Phosphorus (elemental)	G	Cool, 4°C	48 hours.
50. Phosphorus, total	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
53. Residue, total	P, G	Cool, 4°C	7 days.
54. Residue, Filterable	P, G	.....do	48 hours.
55. Residue, Nonfilterable (TSS)	P, G	.....do	7 days.
56. Residue, Settleable	P, G	.....do	48 hours.
57. Residue, volatile	P, G	.....do	7 days.
61. Silica	P	.....do	28 days.
64. Specific conductance	P, G	.....do	Do.
65. Sulfate	P, G	.....do	Do.
66. Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH>8	7 days.
67. Sulfite	P, G	None required	Analyze immediately.
68. Surfactants	P, G	Cool, 4°C	48 hours.
69. Temperature	P, G	None required	Analyze.
73. Turbidity	P, G	Cool, 4°C	48 hours.
Table IC—Organic Tests:⁸			
13, 18-20, 22, 24-28, 34-37, 39-43, 45-47, 56, 66, 68, 69, 82-85, 87. Purgeable Halocarbons.	G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	14 days.
6, 57, 80. Purgeable aromatic hydrocarbons	.....do	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ , HCl to pH2 ⁹	Do.
3, 4. Acrolein and acrylonitrile	.....do	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ , Adjust pH to 4-5 ¹⁰	Do.
23, 30, 44, 49, 53, 67, 70, 71, 83, 86, 88. Phenols ¹¹	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	7 days until extraction, 40 days after extraction.
7, 38. Benzodioxines ¹¹	.....do	.....do	7 days until extraction. ¹²
14, 17, 48, 50-52. Phthalate esters ¹¹	.....do	Cool, 4°C	7 days until extraction, 40 days after extraction.
72-74. Nitroamines ^{13,14}	.....do	Cool, 4°C, store in dark, 0.008% Na ₂ S ₂ O ₅ ⁵	Do.
78-82. PCBs ¹¹ acrylonitrile	.....do	Cool, 4°C	Do.
54, 55, 65, 69 Nitroaromatics and isophorone ¹¹	.....do	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵ store in dark.	Do.
1, 2, 5, 8-12, 32, 33, 58, 59, 64, 68, 84, 88. Polynuclear aromatic hydrocarbons. ¹¹	.....do	.....do	Do.
15, 16, 21, 31, 75. Haloethers ¹¹	.....do	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	Do.
29, 35-37, 60-63, 91. Chlorinated hydrocarbons ¹¹	.....do	Cool, 4°C	Do.
87. TCDD ¹¹	.....do	Cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁵	Do.
Table ID—Pesticides Tests:			
1-70. Pesticides ¹¹	.....do	Cool, 4°C, pH 5-8 ¹⁴	Do.
Table IE—Radiological Tests:			
1-5. Alpha, beta and radium	P, G	HNO ₃ to pH<2	6 months.

TABLE 1 NOTES

¹ Polyethylene (P) or Glass (G).

* Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation requirements for hazardous materials. The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.82 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

* Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details.

*Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present.

*Samples should be filtered immediately on-site before adding preservative for dissolved metals.

^aGuidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

*The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of

sample integrity. When the analyses of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.005*N* sodium thiosulfate, storing in the dark, and adjusting the pH to 6–8; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzene).

If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

¹⁰ Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxygen-free) atmosphere.

*The oil adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008%

The pH adjustment may be performed upon receipt in the laboratory, and may be checked with samples of the untreated water. The pH adjustment may be checked with samples of the untreated water.

Figure 10.10

shipment. In many programs, the sampler will need to split the sample into several different samples, specifying different sample containers and preservation methods for each sample based on the analyses of interest.

2.0 SAMPLE CONTAINERS

Selection of sample containers should be based on the analytical parameters of interest. The containers should be made of materials that are nonreactive. Glass and polyethylene containers are the most commonly accepted, and both may be used when sampling many constituents. When metals are the analytes of interest, however, polyethylene containers with polypropylene caps are preferred. When organics are the analytes of interest, glass containers with teflon-lined caps must be used. When choosing containers for an individual monitoring program, the sampler should refer to the selected analytical method being used. The documentation of analytical procedures generally includes a listing of acceptable containers.

Depending on the analyses to be performed and the nature of the samples being collected, the sample container must be treated according to specific procedures. Bottles should be washed as described in 'general bottle washing' if: (1) they will be stored for later (not specified) usage, (2) they will be used for composite samples for a variety of routine analyses, (3) they will be used for routine analyses not requiring special preparation.

2.1 General Bottle Cleaning

2.1.1 Bottle Material

Polypropylene, glass, Teflon

2.1.2 Bottle Size

Dependent upon determinatioons required.

2.1.3 Cleaning Reagents

1. Phosphate-free detergent
2. Distilled water
3. Reagent-grade methanol

2.1.4 Procedure

1. Rinse bottles with tap water.
2. Soak bottles in detergent solution for approximately thirty (30) minutes.
3. Scrub bottles with a brush.
4. Rinse bottles several times with tap water to remove the detergent.
5. Rinse bottles thoroughly, several times, with distilled water.
6. Rinse bottles with methanol.
7. Bake for one hour at 300', or air dry.

2.2 Bottle Cleaning for Metals Determination

2.2.1 Bottle Material

Polypropylene, borosilicate glass, or Teflon

2.2.2 Bottle Size

200-500 ml

2.2.3 Cleaning Reagents

1. Detergents
2. 1:1 Nitric acid

3. 1:1 Hydrochloric acid
4. Distilled water

2.2.4 Procedure

1. Follow general bottle cleaning procedure.
2. Add 1:1 nitric acid to bottles, cap, and shake briefly.
3. Allow bottles to stand for approximately 30 minutes, shaking them intermittently.
4. Pour acid from bottles and rinse them with tap water.
5. Repeat steps 2, 3, and 4 with 1:1 hydrochloric acid.
6. Rinse bottles thoroughly, several times, with deionized distilled water.

Note 1: Chromic acid may be useful to remove organic deposits from glassware; however, the analyst should be cautioned that the glassware must be thoroughly rinsed with water, and that the last traces of chromium are nearly impossible to remove. This is especially important if chromium is to be included in the analytical scheme. A commercial product - NOCHROMIX - available from Godax Laboratories, 6 Varick Street, New York, N.Y. 10013, may be used in place of chromic acid. [Chromic acid should not be used with plastic bottles.]

Note 2: If it can be documented through an active analytical quality control program using spiked samples, reagent and sample blanks, that certain steps in the cleaning procedure are not required for routine samples, those steps may be eliminated from the procedure.

2.3 Bottle Cleaning for Oil and Grease Determinations

2.3.1 Bottle Material

Glass with Teflon-lined cap

2.3.2 Bottle Size

One (1) liter

2.3.3 Cleaning Reagents

1. Acid solution of 1+1 nitric acid
2. Detergent
3. Distilled water
4. Freon-113

2.3.4 Procedure

1. Follow general bottle cleaning procedure.
2. Rinse bottles (excluding caps) with acid solution.
3. Pour acid from bottles and rinse them with tap water.
4. Rinse bottles thoroughly, several times, with distilled water.
5. Rinse bottles with Freon-113.

2.4 Bottle Cleaning for Extractable Organics

2.4.1 Bottle Material

Glass with Teflon-lined cap.

2.4.2 Bottle Size

One (1) gallon

2.4.3 Cleaning Reagents

1. Detergent
2. Distilled water
3. Pesticide grade hexane

2.4.4 Procedure

1. Follow general bottle cleaning procedure.
2. Rinse bottles several times with distilled water.
3. Rinse bottles and caps two times with pesticide-quality hexane.

3.0 PRESERVATION TECHNIQUES

Samples should be preserved at low temperatures in the dark during transport to the laboratory for analysis. Appropriate chemical preservation should be performed in the field for various analytical parameters at the time of sampling. Regardless of the method of preservation, analyses should be performed as soon after sampling as is practicably possible in accordance with EPA and Standard Methods holding times.

Methods of sample preservation are relatively limited and are generally intended to (1) retard biological action, (2) retard hydrolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing. A summary of sample preservation measures is presented in the table below. When selecting preservation techniques for a specific monitoring program, the sampler should again refer to the guidance provided in the documentation of the analytical methods to be used. In some instances, the optimal method for sample preservation may be inappropriate owing to the restrictions placed on

the transport of certain chemicals by shippers. When shipping restrictions prevent the use of some reagents for sample preservation, the most appropriate and permissible technique should be used. Frequently, this will require refrigeration of the sample during transit.

In general, all environmental water samples should be placed in an insulated ice chest, and iced to lower the sample water temperatures to 4°C or less.

Environmental samples are generally dilute (in terms of pollutant concentration) samples taken in an area surrounding a spill or dump site.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, etc. and require special handling procedures because of their potential toxicity or hazard. These samples should not be preserved in any way, including refrigeration.

3.1 Preservation Techniques for Metals

Before collection of the sample a decision must be made as to the type of data desired, i.e., dissolved, suspended, total or total recoverable. For container preference, maximum holding time and sample preservation at time of collection see Table 1. Drinking water samples containing suspended and settleable material should be prepared using the total recoverable metal procedure.

3.1.1 Dissolved

For the determination of dissolved constituents the sample must be filtered through a 0.45 μ membrane filter as soon as practical after collection. (Glass or plastic filtering apparatus using plain, non-grid marked, membrane filters are recommended to avoid possible contamination.)

Summary of Sample Preservation Methods

Preservative	Action	Application
HgCl ₂	Bacterial Inhibitor	Nitrogen forms, phosphorus forms
Acid (HNO ₃)	Metals solvent, prevents precipitation	Metals
Acid (H ₂ SO ₄)	Bacterial inhibitor	Organic samples (COD, oil, and grease, organic carbon)
	Salt formulation with organic bases	Ammonia, amines
Alkali (NaOH)	Salt formulation with volatile compounds	Cyanides, organic acids
Refrigeration	Bacterial inhibitor	Acidity-alkalinity, organic materials, BOD, color, odor, organic N, carbon, etc., biological organism (coliform, etc.)

Use the first 50-100 ml to rinse the filter flask. Discard this portion and collect the required volume of filtrate. Acidify the filtrate with 1:1 redistilled HNO₃ to a pH of <2. Normally, 3 ml of (1:1) acid per liter should be sufficient to preserve the sample (see Note). If hexavalent chromium is to be included in the analytical scheme, a portion of the filtrate should be transferred before acidification to a separate container and analyzed as soon as possible. Analyses performed on a sample so treated shall be reported as "dissolved" concentrations.

Note: If a precipitate is formed upon acidification, the filtrate should be digested using 3.1.3. As much as 25

ml of conc. HCl/liter, may be required to stabilize certain types of highly buffered samples if they are to be stored for any length of time. Therefore, special precautions should be observed for preservation and storage of unusual samples intended for metal analysis.

3.1.2 Suspended

For the determination of suspended metals a representative volume of unpreserved sample must be filtered through a 0.45 μ membrane filter. When considerable suspended material is present, as little as 100 ml of a well mixed sample is filtered.

3.1.3 Total

For the determination of total metals the sample is acidified with 1:1 redistilled HNO_3 to a pH of less than 2 at the time of collection. The sample is not filtered before processing. Choose a volume of sample appropriate for the expected level of metals. If much suspended material is present, as little as 50-100 ml of well mixed sample will most probably be sufficient. (The sample volume required may also vary proportionally with the number of metals to be determined.)

3.1.4 Total Recoverable

To determine total recoverable metals, acidify the entire sample at the time of collection with conc. redistilled HNO_3 , 5 ml/l.

3.2 Preservation Technique for Cyanide

3.2.1 Chemical Preservative

NaOH

Ascorbic acid (used only in presence of residual chlorine)

3.2.2 Procedure

1. Add 2 ml of 10 N NaOH per liter of sample. This should increase the pH to greater than 12.
2. Samples should be analyzed as rapidly as possible after collection. If storage is required, the samples should be stored in a refrigerator or in an ice chest filled with water and ice to maintain temperature at 4°C.
3. Oxidizing agents such as chlorine decompose most of the cyanides. Test a drop of the sample with potassium iodide-starch test paper (KI starch paper); a blue color indicates the need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.

3.3 Preservation Techniques for Nitrogen

3.3.1 Ammonia

Add 2 ml conc. H_2SO_4 per liter and cool to 4°C.

3.3.2 Kjeldahl, Total

Samples may be preserved by addition of 2 ml of conc. H_2SO_4 per liter and stored at 4°C. Even when preserved in this manner, conversion of organic nitrogen to ammonia may occur. Preserved samples should be analyzed as soon as possible.

3.3.3 Nitrate Plus Nitrite, Nitrate

Analysis should be made as possible. If analysis can be made within 24 hours, the sample should be preserved by refrigeration at 4°C. When samples must be stored for more than 24 hours, they should be preserved with sulfuric acid (2 ml H_2SO_4 per liter) and refrigeration.

Caution: Samples for reduction column must not be preserved with mercuric chloride.

3.3.4 Nitrite

Samples should be analyzed as soon as possible. They may be stored for 24 to 48 hours at 4°C.

3.4 Preservation Technique for Dissolved Oxygen (Winkler)

3.4.1 Where possible, collect the sample in a 300 ml BOD incubation bottle. Special precautions are required to avoid entrainment or solution of atmospheric oxygen or loss of dissolved oxygen.

3.4.2 Where samples are collected from shallow depths (less than 5 feet), use of an APHA-type sampler is recommended. Use of a Kemmerer type sampler is recommended for samples collected from depths of greater than 5 feet.

3.4.3 When a Kemmerer sampler is used, the BOD sample bottle should be filled to overflowing (overflow for approximately 10 seconds). Outlet tube of Kemmerer should be inserted to bottom of BOD bottle. Care must be taken to prevent turbulence and the formation of bubbles when filling bottle.

3.4.4 At time of sampling, the sample temperature should be recorded as precisely as required.

3.4.5 Do not delay the determination of dissolved oxygen in samples having an appreciable iodine demand or containing ferrous iron. If samples must be preserved either method below may be employed.

3.4.5.1 Add 2 ml of manganous sulfate solution and then 2 ml of alkaline iodide-azide solution to the sample contained in the BOD bottle. Both reagents must be added well below the surface of the liquid. Stopper the bottle immediately and mix the contents thoroughly. The sample should be stored at the temperature of the collection water, or water sealed and kept at a temperature of 10 to 20°C, in the dark.

3.4.5.2 Add 0.7 ml of conc. H_2SO_4 and 1 ml sodium azide solution (2 g NaN_3 in 100 ml distilled water) to sample in the BOD bottle. Store sample as above.

3.4.6 If either preservation technique is employed, complete the analysis within 4-8 hours after sampling.

3.5 Preservation Technique for Phosphorus

1. If benthic deposits are present in the area being sampled, great care should be taken not to include these deposits.
2. Sample containers may be of plastic material, such as cubitainers, or of Pyrex glass.
3. If the analysis cannot be performed the same day of collection, the sample should be preserved by the addition of 2 ml conc. H_2SO_4 per liter and refrigeration at 4°C.

3.6 Preservation Technique for Sulphide

1. Samples must be taken with a minimum of aeration. Sulfide may be volatilized by aeration and any oxygen inadvertently

added to the sample may convert the sulfide to an unmeasurable form.

2. If the sample is not preserved with zinc acetate and NaOH, the analysis must be started immediately. Similarly, the measurement of dissolved sulfides must also be commenced immediately.

3.7 Preservation Techniques for Organics

3.7.1 Chemical Oxygen Demand

1. Collect the samples only in glass bottles with teflon-lined caps.
2. Biologically active samples should be tested as soon as possible.
3. The collection of a composite sample and/or division of the sample into separate aliquots is not generally possible due to losses on equipment and imperfect mixing.
4. Samples should be preserved with sulfuric acid to a pH <2 and maintained at 4°C until analysis.

3.7.2 Oil and Grease; Petroleum Hydrocarbons

1. A representative sample of 1 liter volume should be collected in a glass bottle. Because losses of grease will occur on sampling equipment, the collection of a composite sample is impractical. The entire sample is consumed by this test; no other analysis may be performed using aliquots of the sample.
2. A delay between sampling and analysis of greater than 4 hours requires sample preservation by the addition of 5 ml HCl. A delay greater than 48 hours also requires refrigeration for sample preservation.

3.7.3 Organic Carbon

1. Sampling and storage of samples in glass bottles is preferable. Sampling and storage in plastic bottles such as conventional polyethylene and cubitainers is permissible if it is established that the containers do not contribute contaminating organics to the

samples. Note: A brief study performed in the EPA Laboratory indicated that distilled water stored in new, one quart cubitainers did not show any increase in organic carbon after two weeks exposure.

2. Because of the possibility of oxidation or bacterial decomposition of some components of aqueous samples, the lapse of time between collection of samples and start of analysis should be kept to a minimum. Also, samples should be kept cool (4°C) and protected from sunlight and atmospheric oxygen.
3. In instances where analysis cannot be performed within two hours (2 hours) from time of sampling, the sample is acidified ($\text{pH} < 2$) with HCl or H_2SO_4 .

3.7.4 Phenolics

1. Biological degradation is inhibited by the addition of 1 g/l of copper sulfate to the sample and acidification to a pH of less than 4 with phosphoric acid. The sample should be kept at 4°C and analyzed within 24 hours after collection.

4.0 REFERENCE

- U.S. EPA, 1983. Methods for the chemical analysis of water and wastes. March 1983. EPA-600/4-79-020.
- A.P.H.A. 1975. Standard methods for the examination of water and wastewater. 14th ed.
- U.S. EPA, 1983. Test methods for evaluating solid waste. SW-846.
- U.S. EPA, 1983. RCRA Permit Writer's Manual: Ground-Water Protection (40 CFR Part 264, Subpart F), Geotrans Inc., EPA Contract No. 68-01-6464.
- USEPA/NWWA, 1981. Manual of Ground-Water Sampling Procedures, NWWA/EPA Series.
- U.S. EPA, 1984. 40 CFR Part 136. Federal Register Part VIII. October 26, 1984.

Procedure: 5622007
Revision: 0
Date: 3/85
Page: 1 of 1

SAMPLES COLLECTED FOR QUALITY CONTROL PURPOSES

1.0 INTRODUCTION

To provide an indication of analytical precision and accuracy, either 10 percent of all samples, or 1 of every 10 or less samples collected per day, are collected in duplicate. These samples are submitted to the laboratories either as duplicate or as blind samples. Blind samples receive a sample identification number, different from the actual sample location. Actual identification of blinds will be noted in the Field Notebook. The Chain-of-Custody Record will note the unique number and describe the sample as "duplicate", without revealing the actual sampling location.

2.0 FIELD BLANKS

To monitor possible contamination of sample containers, distilled water blanks will be carried into the field. One blank is analyzed for each sample type (i.e., soil, surface water, baling wells) collected during each day of sampling. Blanks are to be analyzed for all parameters specified for the particular sample type during particular field day. Blind blanks will receive a unique sample identification number. Analytical blanks or controls will be provided to contractor laboratories as requested and are identified as blanks.

Procedure: 6600001
Revision: 0
Date: 3/85
Page: 1 of 3

EQUIPMENT AND INSTRUMENT CALIBRATION AND MAINTENANCE, GENERAL REQUIREMENTS

1.0 INTRODUCTION

The general guidelines for calibrating and maintaining instruments and monitoring equipment are presented in this document.

2.0 CALIBRATION AND MAINTENANCE PROCEDURES

Calibration and maintenance procedures are documented for each piece of equipment affecting quality. Calibration and maintenance procedures are developed based on manufacturer's specifications and are retained in the Site Investigation Procedures Manual. These procedures include, but are not limited to:

1. Equipment identification (name) and description.
2. Equipment specifications.
3. Calibration and/or maintenance schedule.
4. Equipment necessary to accomplish calibration (where applicable).
5. Procedure for calibration and/or maintenance.

3.0 CALIBRATION LABEL

Instruments requiring calibration and/or maintenance have a prominently displayed sticker containing the following information:

1. Date of calibration and/or maintenance.
2. Next due date for calibration and/or maintenance.
3. Initials of person performing calibration and/or maintenance.
4. Span gas and concentration(s) (if applicable).
5. Span or sensitivity setting (if applicable).

4.0 EQUIPMENT LOG BOOK

An equipment log book is issued to record the life history of each measuring and testing device used in activities affecting quality. This book is a three ring binder in which individual records for each piece of equipment are maintained. A form such as F6101 or a reasonable facsimile should be used to maintain the calibration and maintenance record. The record should include:

1. Equipment identification (name) and control number.
2. Date of calibration and/or maintenance.
3. Condition of equipment.
4. Activity performed on instrument (calibration and/or maintenance).
5. Adjustments made and accuracy of equipment prior to and following calibration (where applicable).
6. Record of equipment failure or inability to meet specifications (where applicable).
7. Initials of person performing calibration/maintenance.
8. Next due date for calibration and/or maintenance.

5.0 CALIBRATION/MAINTENANCE FORM

An instrument specific calibration/maintenance form will be developed to record data relating to each individual calibration/maintenance event. A single form will be used for each calibration/maintenance event. In addition to the data recorded in the calibration/maintenance log, the following items should also be included in the instrument specific form (where applicable).

1. Calibration calculations and curves.
2. Span gas type and concentrations.
3. Span or sensitivity range settings.
4. Specifics on repairs and parts replaced, added, or removed.

Procedure: 6600001
Revision: 0
Date: 3/85
Page: 3 of 3

5. Instrument's overall condition.

6.0 FIELD CALIBRATION

As part of normal field operations, some instruments require calibration prior to, during, and/or after field use. This field operation calibration should remain separate from pre-field calibrations and should not be used as a substitute for standard calibration activities. Field calibration should be recorded in field log books or on field forms as part of the normal field data collection process. Field calibration records should not be included in the history log.

7.0 INSTRUMENTS NOT IN COMPLIANCE

If the calibration schedule is not adequately maintained, or if accuracy as reported in specifications cannot be attained for a specific instrument, that instrument is labelled "HOLD" and is unavailable for use until it is repaired and specifications are attained.

CALIBRATION PROCEDURE FOR THE HNu PI 101

1.0 INTRODUCTION

1.1 Content

This procedure presents the steps required to calibrate the HNu Model PI 101 photoionization analyzer. This instrument should be calibrated after each field use or prior to each field use if the instrument has not been calibrated during the previous 14 calendar days. The principle of detection and operating procedures are described in Procedure 5607001. This procedure presents calibration steps only.

1.2 Equipment

- o Calibration Gas (2 ranges)

Low range 0-20 ppm and mid range 20-200 ppm Isobutylene gas for standard field operation when contaminants are unknown or a mixture of gases is present. Isobutylene is the gas used for general calibration because of the instrument's relatively high sensitivity to it and the non-toxic nature of the gas.

Note: A specialty gas may be required if a single atmospheric contaminant is present and the contaminant has a sensitivity different from that of the calibration gas. See procedure for 5607001 for a discussion on specialty calibration.

- o Tubing and fittings (See Figure 1).
- o Rotometer or bubble flow meter.
- o Calibration Form F6264.
- o Table 1 for ionization potentials for compounds of interest.

Procedure: 6607001
Revision: 0
Date: 3/85
Page: 2 of 15

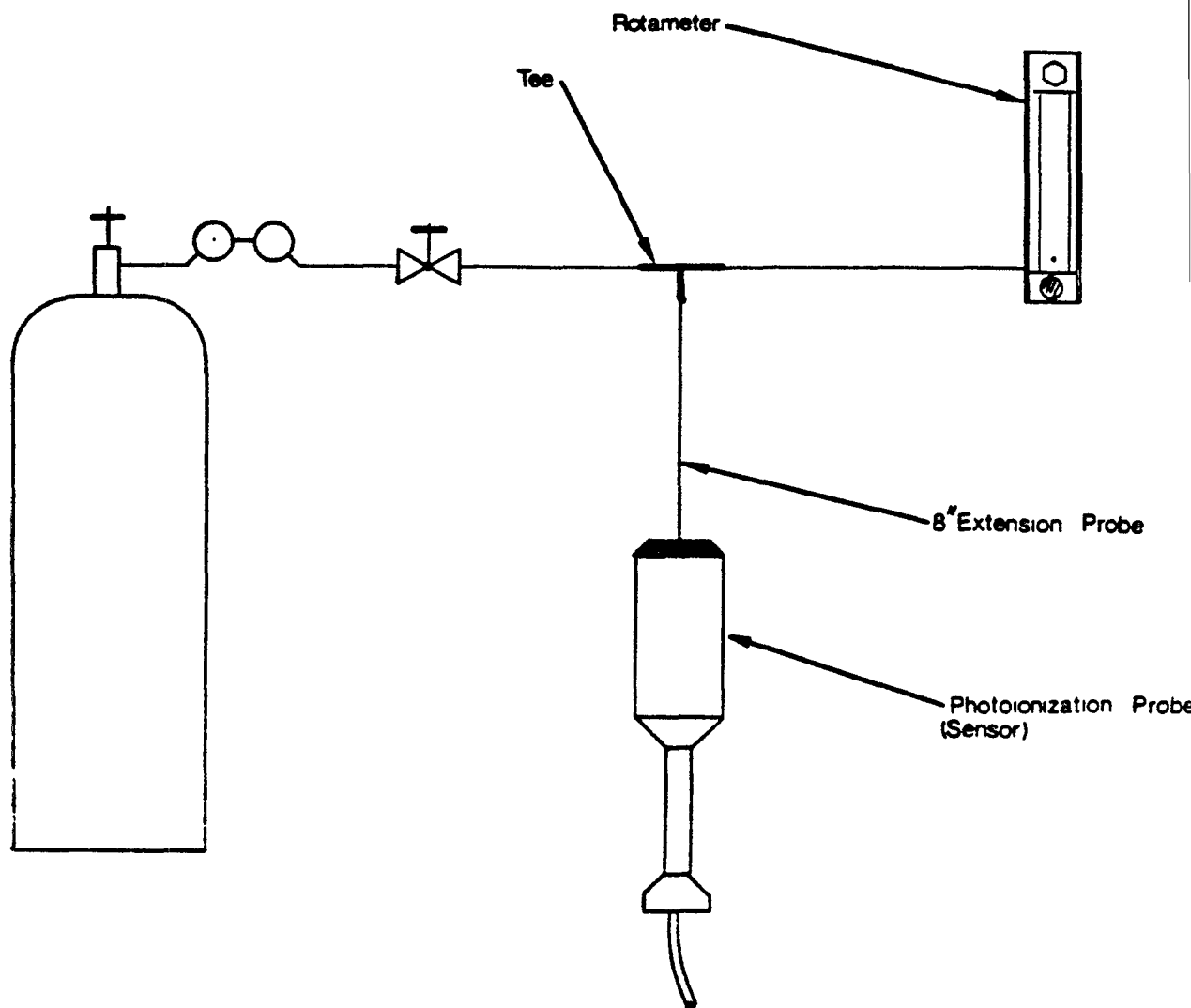


FIGURE 1 RECOMMENDED CALIBRATION PROCEDURE FOR PHOTOIONIZATION ANALYZER

Procedure: 6607001

Revision: 0

Date: 3/85

Page: 3 of 15

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp)

Species	Photoionization Sensitivity*
p-xylene	11.4
m-xylene	11.2
benzene	10.0 (reference standard)
toluene	10.0
diethyl sulfide	10.0
diethyl amine	9.9
styrene	9.7
trichloroethylene	8.9
carbon disulfide	7.1
isobutylene	7.0
acetone	6.3
tetrahydrofuran	6.0
methyl ethyl ketone	5.7
methyl isobutyl ketone	5.7
cyclohexanone	5.1
naptha (85% aromatics)	5.0
vinyl chloride	5.0
methyl isocyanate	4.5
iodine	4.5
methyl mercaptan	4.3
dimethyl sulfide	4.3
allyl alcohol	4.2
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
α -pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6

Procedure: 6607001

Revision: 0

Date: 3/85

Page: 4 of 15

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp) (Continued)

Species	Photoionization Sensitivity*
b-pinene	0.5
citral	0.5
ammonia	0.3
acetic acid	0.1
nitrogen dioxide	0.02
methane	0.0
acetylene	0.0

*Expressed in ppm (v/v).

2.0 CALIBRATION PROCEDURE

2.1 CDM employs a two-point standardization procedure to facilitate proper instrument calibration over the 0-20 ppm and 20-200 ppm operating ranges. Two distinct mixtures of the calibration gas (isobutylene) in air are used. Each mixture should give a 3/4 scale deflection in its respective operating range.

2.2 Instrument Setup.

2.2.1 Remove Instrument cover by pulling up on the side straps.

2.2.2 Prior to calibration, check the function switch (Figure 2) on the control panel to make sure it is in the OFF-positon. The probe nozzle, is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.

2.2.3 Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.

2.2.4 Attach probe cable to instrument box by inserting 12 pin interface connector of the probe cable into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.

2.2.5 Turn the function switch to the Battery Check position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red LED light

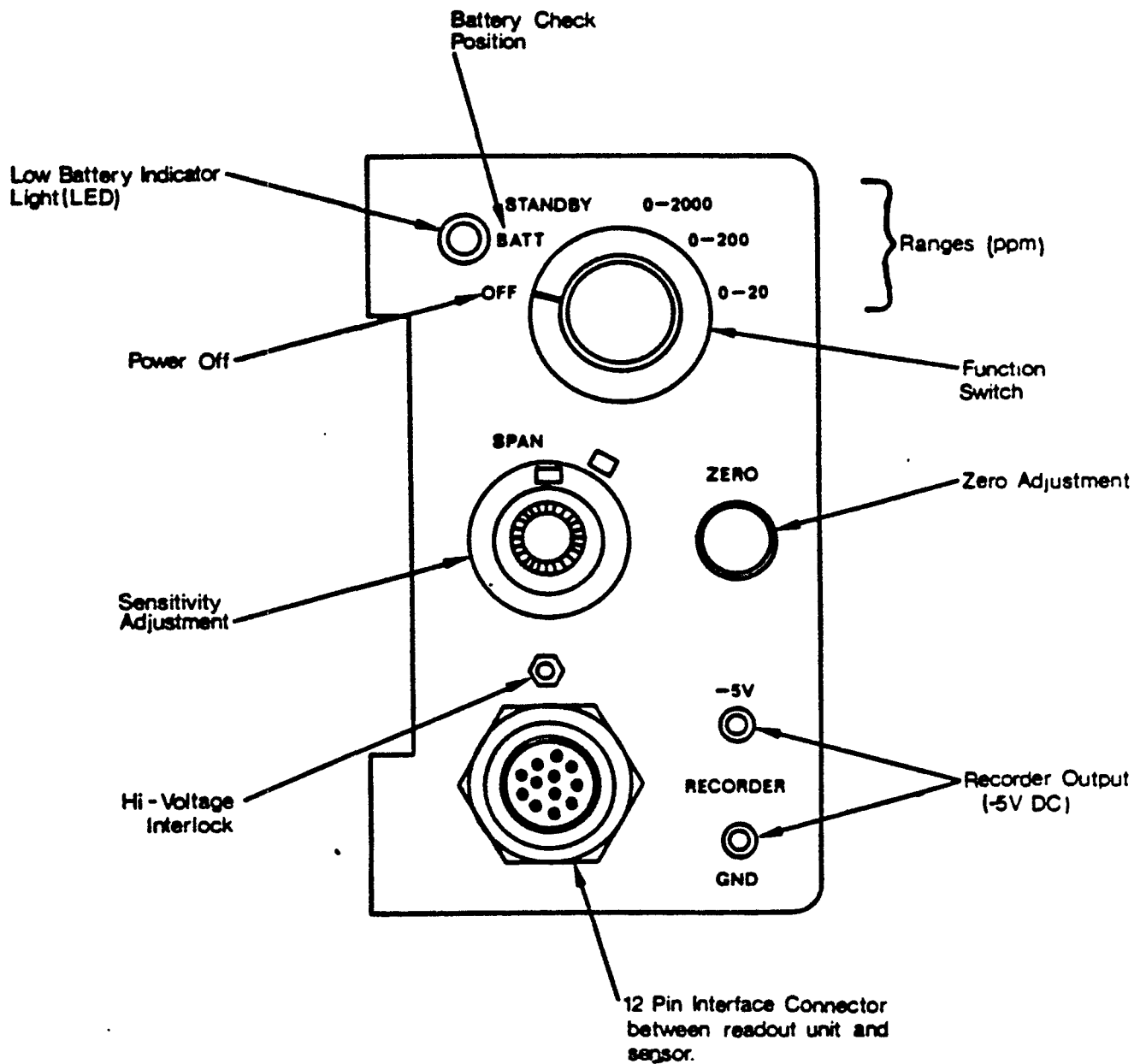


FIGURE 2 CONTROL PANEL FEATURES

comes on, the instrument should be recharged prior to making any measurements. Implement step 3.0 to recharge battery.

- 2.2.6 Turn the function switch to the ON position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. Do not look directly at the lamp itself. If the lamp does not come on refer to maintenance step 4.1.2.
- 2.2.7 To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downscale deflection. (Note: no zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibration, the zero should be rechecked and adjusted. If necessary wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.

2.3 Calibration Steps

- 2.3.1 Insert one end of T tube (Figure 1) into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotometer (bubbler) attached.
- 2.3.2 Set the function switch in the 0-200 ppm range.

Procedure: 6607001
Revision: 0
Date: 3/85
Page: 8 of 15

- 2.3.3 Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotometer. The instrument will draw in the volume required for detection with the rotometer indicating excess flow.
- 2.3.4 Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder).
- 2.3.5 Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 2.3.7.
- 2.3.6 Record on form F6264 all original and readjusted settings as specified in the form.
- 2.3.7 Next, set the function switch to the 0-20 ppm. Remove the mid range (20-200 ppm) calibration gas cylinder and attach the low range (0-20 ppm) calibration gas cylinder as described above.
- 2.3.8 Do not adjust the span potentiometer. The observed reading should be ± 3 ppm of the concentration specified for the low range calibration gas. If this is not the case, recalibrate the mid range scale repeating procedures 3.3.1 to 3.2.7 above. If the low range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window following step 4.1.3. When the observed reading is within the required tolerances, the instrument is fully calibrated.

Procedure: 6607001
Revision: 0
Date: 3/85
Page: 9 of 15

2.3.9 Complete forms F6264 and F6265 for the respective instrument being calibrated.

3.0 BATTERY RECHARGING

- 3.1 Place plug on end of charger cable into jack on left side of instrument case
- 3.2 Plug charger into 120V AC supply.
- 3.3 To ensure that charger is functioning, turn the function switch to the battery check position. The meter should go upscale if the charger is working correctly and correctly inserted.
- 3.4 The battery is completely charged overnight (ca, 14 hours).
- 3.5 When disconnecting charger, remove from 120 V AC before removing mini phone plug.

4.0 TROUBLE SHOOTING AND MAINTENANCE

4.1 General Fault Determination and Correction

- 4.1.1 Battery level is low. Recharge if necessary implementing step 3.0. If the battery will not recharge it will have to be replaced.
- 4.1.2 UV lamp function. Gaze at sample inlet when mode switch is on an instrument function position and observe for purple glow of lamp. If the lamp does not glow in any of the three instrument function positions, it may be burned out and will have to be replaced. To replace the lamp:

1. Turn the function switch to the off position and disconnect the probe connector from the readout unit.
2. Remove the exhaust screw found near the base of the probe (Figure 3).
3. Grasp the end cap in one hand and the probe shell in the other and gently pull to separate the end cap and lamp housing from the shell.
4. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber does not fall out of the end cap and the lamp does not slide out of the lamp housing.
5. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out of it.
6. Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.
7. Replace lamp with one of same energy source as the one removed by sliding it into the housing. Note: the amplifier board and instrument circuitry are calibrated for one light energy source. Insertion of a lamp of a different energy level will produce false instrument readings.
8. Place the ion chamber on top of the lamp housing, checking to ensure that the contacts are aligned.
9. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. Do not overtighten.
10. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. Do not force the assembly as it only fits one way.
11. Replace and tighten the exhaust screw.
12. Reconnect the 12 pin connector and turn instrument mode switch to a function position. Check for glow of lamp. If lamp still does not function the instrument has an electrical short or other problem that will have to be corrected at the factory.

Procedure: 6607001
Revision: 0
Date: 3/85
Page: 11 of 15

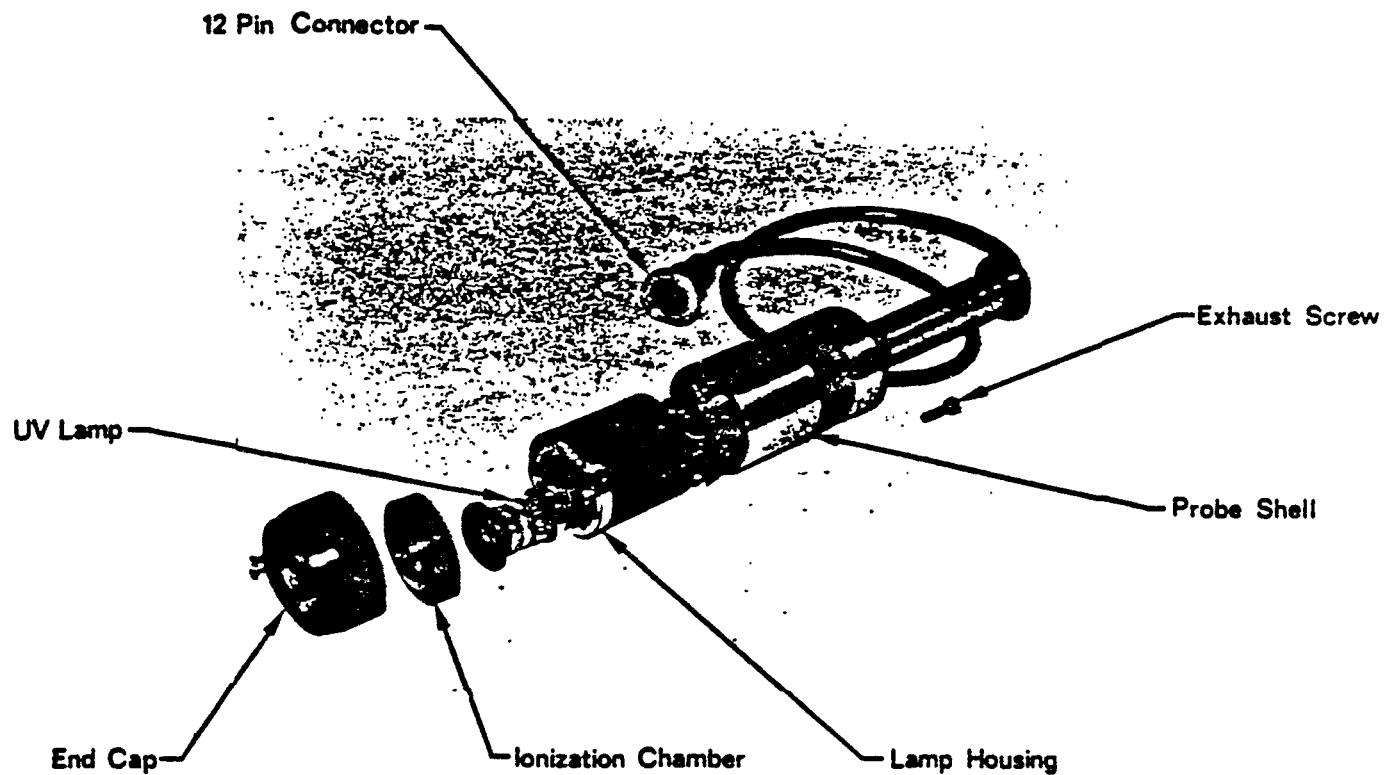


FIGURE 3 COMPONENT PARTS OF PROBE

4.1.3 Instrument appears to be functional, but responses are lower than expected or erratic. The window of the light source may be dirty and need to be cleaned. To clean the light source window:

1. Disassemble the probe assembly by repeating steps 1 through 6 under 4.1.2 above.
2. Clean the window of the light source using compound provided with instrument and soft clean cloth.
Important: use cleaning compound on the window of the 10.2 eV lamp only. The cleaning compound may damage the windows of the 9.5 and 11.7 eV lamps.
3. Reassemble the probe assembly repeating step 7 through 12 above.

4.2 Specific Faults

4.2.1 No meter response in any switch position (including BATT CHK)

1. Broken meter movement: Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.
2. Electrical connection to meter is broken: Check all wires leading to meter and clean the contacts of quick-disconnects.
3. Battery is completely dead: Disconnect battery and check voltage with a volt-ohm meter.
4. Check 2 amp fuse.
5. If none of the above solves the problem, consult the factory.

4.2.2 Meter responds in BATT CHK position, but reads zero or near zero for all others.

1. Power supply defective: Check power supply voltages per Figure 4. If any voltage is out of specification, consult the factory.
2. Input transistor or amplifier has failed: Rotate zero control; meter should deflect up/down as control is turned. Open probe; both transistors should be fully seated in sockets.
3. Input signal connection broken in probe or readout: Check input connector on printed circuit board. Should be firmly pressed down. Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object. Check all wires in readout for solid connections.

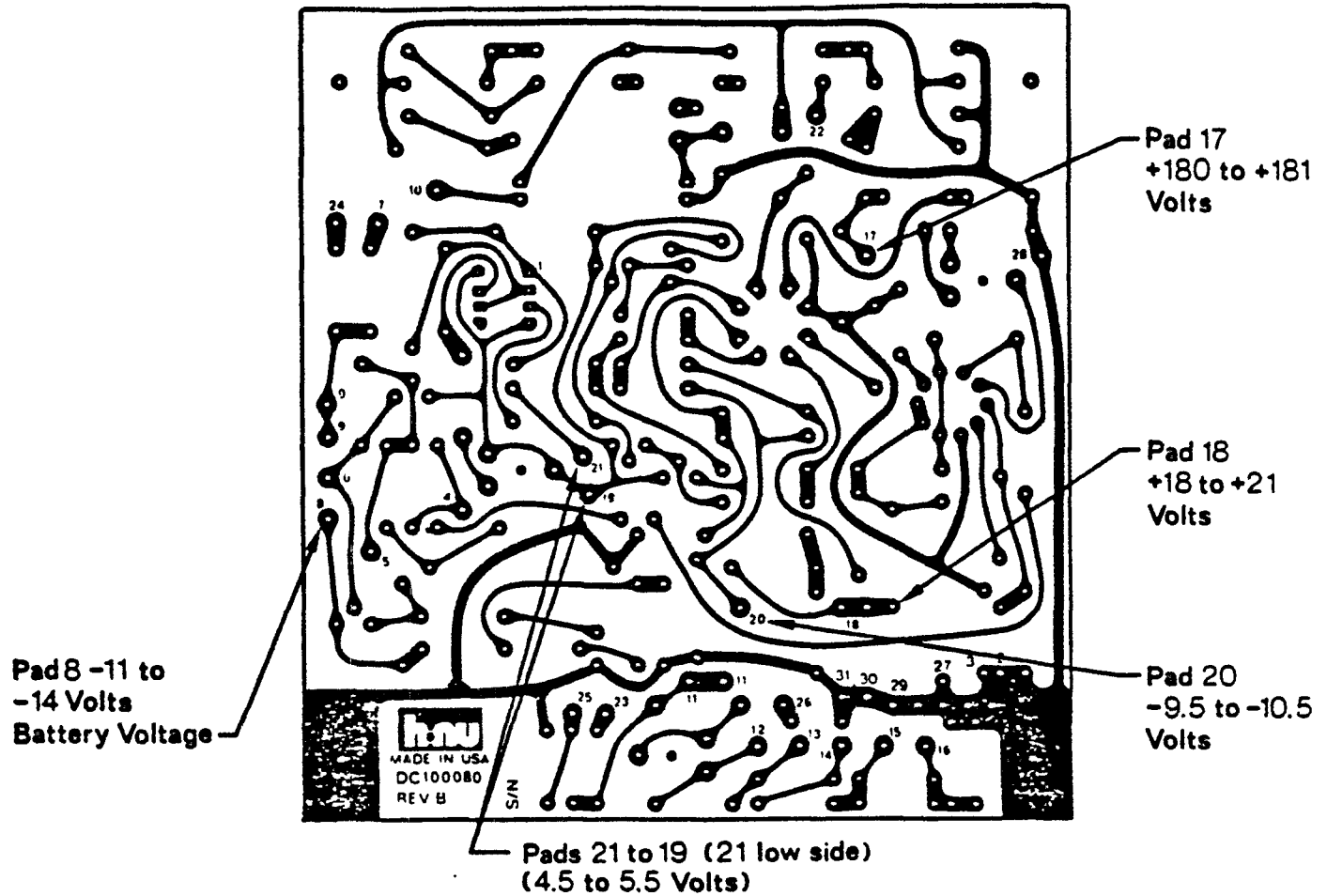
4.2.3 Instrument responds correctly in BATT CHK, and STBY, but not in measuring mode.

1. Check to see the light source is on (See Section 4.1.2).
2. Check high voltage power supply (see Figure 4).
3. Open end of probe, remove lamp and check high voltage on lamp contact ring.
4. If high voltage is present at all above points, light source has most likely failed. Consult the factory.

4.2.4 Instrument responds correctly in all positions, but signal is lower than expected.

1. Check span setting for correct value.
2. Clean window of light source (See 4.1.3).
3. Double check preparation of standards.
4. Check power supply 180 V output. See Figure 4.
5. Check for proper fan operation. Check fan voltage. See Figure 4.
6. Rotate span setting. Response should change if span pot is working properly.

Procedure: 6607001
 Revision: 0
 Date: 3/85
 Page: 14 of 15



All Voltages Respect to Ground							
pads	voltage	pads	voltage	pads	voltage	pads	voltage
1	- 5.7 V	9	- 12.2V	17	180V	25	0
2	GRD	10	- 12.1V	18	+ 19.4V	26	0
3	GRD	11	0	19	- 10.6V	27	GRD
4	-10.7V	12	0	20	- 9.7V	28	0
5	- 11.3V	13	0	21	- 14.5V	29	GRD
6	- 12.1V	14	0	22	- 400V	30	GRD
7	0	15	0	23	0	31	GRD
8	- 12.2V	16	0	24	0		

Figure 4 Power Supply PC Board

4.2.5 Instrument responds in all switch positions, but is noisy (erratic meter movement).

1. Open circuit in feedback circuit. Consult the factory.
2. Open circuit in cable shield or probe shield. Consult the factory.

4.2.6 Instrument response is slow and/or irreproducible.

1. Fan operating improperly. Check fan voltage. See Figure 4.
2. Check calibration and operation.

4.2.7 Low battery indicator.

1. Indicator comes on if battery charge is low.
2. Indicator also comes on if ionization voltage is too high.

CALIBRATION AND MAINTENANCE PROCEDURES
CENTURY SYSTEMS PORTABLE ORGANIC VAPOR ANALYZER MODEL OVA-128

1.0 INTRODUCTION

This procedure presents steps required to calibrate and maintain the model OVA-128 organic vapor analyzer. Specifications and operating principles and procedures are presented in Procedure 5607003.

2.0 CALIBRATION

2.1 General

The OVA is capable of responding to nearly all organic compounds. However, the response will vary from compound to compound. The responses of some compounds relative to methane, are presented in Table 1. For precise analyses it is necessary to calibrate the instrument to a specific compound of interest, particularly if that compound contains elements other than carbon and hydrogen. For general use, the instrument is calibrated to methane.

Internal electronic adjustments are provided to calibrate and align the electronic circuits. There are four such adjustments, all located on the electronics board. One adjustment potentiometer, R-38, is factory set and is used to set the power supply voltage. Potentiometer R-38 thus should never be adjusted. The remaining three adjustments, R-31 (X1), R-32 (X10), and R-33 (X100) are used for setting the electronic amplifier gain for each of the three calibration ranges. Access to the adjustments is accomplished by removing the instrument from its case.

TABLE 1 - RESPONSE OF OVA TO HYDROCARBONS RELATIVE TO METHANE

Compound	Relative Response (%)
Methane	100 (Reference)
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Tolvene	120
Ethane	90
Acetone	60
Methyl Ethyl Ketone	80
Methyl Isobutyl Ketone	100
Methyl Alcohol	15
Ethyl Alcohol	25
Isopropyl Alcohol	65
Carbon Tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

2.2 Methane Calibration

2.2.1 Equipment

- o Calibration gas (75-90 ppm methane)
- o T-tube assembly

2.2.2 Instrument Startup

Start instrument by:

1. Move PUMP switch to ON and check battery condition by moving the INSTR switch to the BATT position.

Recharge battery (section 3.0) if battery level is low.

2. Move INSTR switch to ON and allow 5 minutes for warmup.
3. Place instrument in vertical position and check flow rate.
4. Open the H₂ TANK VALVE and H₂ SUPPLY VALVE.
5. Depress Ignitor button for 6 seconds or until hydrogen ignites, whichever is shorter. If hydrogen fails to ignite, wait 2 minutes and attempt to ignite hydrogen.
6. Once lit, wait 5 minutes for instrument to stabilize before starting calibration procedure.
7. Open instrument cover to expose circuit board.

2.2.3 Calibration

Calibration should be performed in a well ventilated area.

1. Set CALIBRATE switch to X10.
2. For methane calibration the GAS SELECT control should be set to 300. Check to ensure that this control is set at 300.
3. Adjust meter reading to zero by rotating the Calibrate ADJUST (zero) knob.
4. Attach one end of T assembly to methane gas cylinder and the other to the probe.
5. Crack open methane gas cylinder until a slight flow of gas can be detected exiting the open end of the T assembly.
6. Adjust trimpot R-32 on circuit board so that meter reads the equivalent of the calibration gas concentration. This sets the instrument gain for methane with the panel mounted gain adjustment set at 300.

7. Close methane gas cylinder. Turn off H₂ SUPPLY VALVE to put out flame. Wait for flameout alarm to sound to ensure the flame is out.
8. Leave CALIBRATE switch on the X10 position and use CALIBRATE ADJUST (zero) knob to adjust meter reading to 4 ppm.
9. Place CALIBRATE switch in X1 position and, using trimpot R-31 on circuit board, adjust meter reading to 4 ppm. This is the Bias Adjustment for the X1 range.
10. Move CALIBRATE switch to X10 position again. Use CALIBRATE ADJUST (zero) knob to adjust meter to a reading of 40 ppm.
11. Move CALIBRATE switch to X100 position and use trimpot R-33 on circuit board to adjust meter reading to 40 ppm.
12. Move CALIBRATE switch to X10 position and use CALIBRATE ADJUST (zero) knob to adjust meter reading to zero.
13. Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.
14. Shut instrument down by ensuring that the H₂ SUPPLY VALVE and H₂ TANK VALVE are closed and the INSTR and PUMP switches are in the OFF position.
15. Record on instrument calibration label, calibration date, gas, and initials of person performing calibration. Remove old tag and replace it with updated label. Fill out instrument history log form.

2.3 Calibration to Specialty Gas/Vapor

Primary calibration of the instrument is accomplished using a known mixture of a specific gas or vapor.

2.3.1 Equipment

- o Calibration (span) gas (75-90ppm of known gas or vapor)
- o T-tube assembly

2.3.2 Instrument Startup

Follow steps in 2.2.2 above.

2.3.3 Calibration

Calibration should be performed in a well ventilated area.

1. Set CALIBRATE switch to 10.
2. Adjust meter reading to zero by rotating the CALIBRATE ADJUST (zero) knob.
3. Attach one end of T assembly to calibration gas cylinder and the other to the probe.
4. Crack open calibration gas cylinder until a slight flow of gas can be detected exiting the open end of the T assembly. (Caution: if the calibration gas is toxic or highly flammable, calibration should occur underneath a hood.)
5. Adjust GAS SELECT knob on instrument until the meter reads the same level as that of the calibration gas.
6. Turn off calibration cylinder and remove T assembly.
7. The instrument is now calibrated for the specialty gas/vapor. All responses of the instrument should be recorded relative to the specialty gas.
8. Calibration in the X10 range by adjusting the GAS Select knob automatically calibrates the instrument for the X1 and X100 ranges. No further adjustments are necessary.
9. Shut instrument down by closing the H₂ SUPPLY VALVE and H₂ TANK VALVE, and putting the INSTR and PUMP switches in the OFF position.
10. Record in instrument calibration label calibration date, span gas and concentration, span setting, and initials of person performing calibration. Remove old

tag and replace it with updated label. Fill out instrument history log.

3.0 FILLING OF HYDROGEN SUPPLY

The instrument should be completely shut down for hydrogen tank refilling. The refilling should be done in a ventilated area. There should be no potential ignitors or flame in the area.

1. Attach filling hose to external source of hydrogen. Pure hydrogen of 1,600 to 2,300 psi will be required.
2. Crack open valve on hydrogen supply, place FILL/BLEED valve on hose in FILL position and purge hose for 2-3 seconds.
3. Close FILL/BLEED Valve (OFF position) and immediately attach other end of fill hose to instrument fill connection and tighten the connection.
4. Open supply valve external on hydrogen tank 1/2 to 1 turn. Set regulator to 1,600 to 2,300 psi.
5. Open the REFILL Valve and the H₂ Tank VALVE on the instrument.
6. Place FILL/BLEED Valve in FILL position. The instrument hydrogen tank should now be filling.
7. The instrument H₂ Pressure Indicator should now indicate instrument tank pressure. This pressure should approximate that of the external supply tank regulator gauge.
8. After the instrument tank is filled, shut off:
 - a. The REFILL VALVE on the instrument panel.
 - b. The FILL/BLEED Valve on the filling hose assembly.
 - c. The valve on the external hydrogen supply bottle.
9. The supply hose and internal lines on the instrument now contain hydrogen under pressure. To reduce this pressure to atmospheric pressure:
 - a. Turn FILL/BLEED Valve to BLEED position until gas can no longer be heard escaping.

- b. Turn FILL/BLEED Valve to FILL position to allow gas trapped in the connective fittings to go into the hose assembly.
 - c. Turn FILL/BLEED Valve to BLEED position to bleed off this pressure.
 - d. Turn FILL/BLEED Valve to OFF position. Keep valve in OFF position.
10. Close H₂ Tank Valve.
 11. Remove fill hose from instrument. Any gas still under pressure will escape as the connector is removed. Release of gas should only be momentary.
 12. As a check of the integrity of the instrument's hydrogen supply system, observe the H₂ TANK PRESSURE Indicator with the system shut down. Release of internal pressure should not go down rapidly. If there is a rapid decrease (greater than 350 PSIG/hour) with the instrument in shut down mode, there is a significant leak in the H₂ supply system. If so, the instrument should be returned to the manufacturer for repairs.

4.0 BATTERY RECHARGING

The battery should be recharged following each use of 4 hours or more, or when the battery check indicator indicates need of a charge. Never charge instrument in hazardous environment or when refilling hydrogen tank.

1. Remove cover from battery charge part on instrument.
2. Plug charger BNC connector into mating connector on battery cover and insert AC plug into 115 VAC wall outlet.
3. Move battery charger switch to the ON position. The light above the switch should illuminate.
4. Battery charge condition is indicated by the meter on the front panel of the charger; meter will deflect to the right while charging. When fully charged, the pointer will be in line with the charged mark above the scale.
5. Approximately 1 hour of charging time is required for each hour of operation; 12 hours for complete charge. Do not charge for more than 24 hours.

5.0 MAINTENANCE

5.1 General

Section 6.0 of the Model OVA-128 Instruction and Service Manual contains detailed maintenance and repair procedures for servicing the OVA. These procedures are not repeated here. Equipment managers are referred to the manual for repair of the OVA.

Equipment managers should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all safety considerations regarding use and maintenance of this instrument be understood. There should be no potential igniters or flame in the area when filling, emptying, or purging the hydrogen system and the instrument should be in shut-down mode.

5.2 Trouble Shooting

Table 2 presents common problems and corrective actions for repairing the instrument.

6.0 REFERENCE

Foxboro Analytical. No date. Instruction and Service Manual, Century Systems Portable Organic Vapor Analyzer Model OVA-128 (M1 2R900AC).

TABLE 2

TROUBLE	TROUBLE SHOOTING PROCEDURE	REMEDY
1) Low sample flow rate on flow indicator	a) Check teflon tubing on valve assembly for kinks, etc. b) Check flow rate with valve in down position.	Straighten or replace teflon tubing Check for over restriction of charcoal filter
2) H ₂ flame will not light	a) Check column connections on top of unit to make sure they are tight. b) Check column for sharp bends or kinks. (Hydrogen flows through this column at all times and a sharp bend will compact packing too tightly for proper hydrogen flow.) c) Check charcoal filter fittings to make sure they are tight. d) Check H ₂ flow rate from the column. e) Check that the Inject and Backflush Valves are both completely in or out. A partially activated valve will block the H ₂ and air flow paths. f) If a new column was installed prior to problem identification, check for proper hydrogen flow rate through the column (should be approximately 12 cc/minute). Reference paragraph 7.1.4.2 d.	Tighten fittings Replace column Tighten fittings Adjust hydrogen pressure to obtain 12 cc/min. flow rate. Ensure both valves are either completely in or out. Increase hydrogen pressure to obtain proper hydrogen flow rate or if column is excessively restrictive, replace or repack the column.
3) Ambient background reading in clean environment is too high	a) Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going in to the chromatographic mode. Reference paragraph 7.1.5.2 b. b) Check for contamination in column. Reference paragraph 7.1.5.2 a c) Check for contamination in column valve assembly.	Replace activated charcoal in charcoal filter assembly. Replace or clean column. Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants.
4) Flame-out when operating either valve	a) Ensure valves are being operated with a quick, positive motion. b) Either H ₂ or air may be leaking around one or more of the valve quad rings. Assess by tests and "O" ring inspection. c) Damaged or worn quad rings causing leak.	Operate valve with a positive motion. Remove stems and lightly coat with silicone grease, only on contact surface of the "O" ring. Wipe off excess (do not remove quad rings). Replace quad rings and grease as above.
5) Excessive peak tailing	a) Change or clean GC column and see if problem disappears. b) Inspect GC valves for excessive silicone grease or contamination.	Ensure columns are clean prior to use. Refer to paragraph 7.1.5.2 a for cleaning instructions. If one of a same type of column tails worse than others, repack the column or discard. Excessive lubricant or foreign matter in the valve assembly can cause excessive tailing. Clean valve assemblies and lightly relubricate as required. Lubricant should be put only on the outside contact surface of the "O" ring. Do not get grease into "O" ring

Procedure: 6617002
Revision: 0
Date: 4/85
Page: 1 of 6

CALIBRATION AND MAINTENANCE PROCEDURE YSI MODEL 33 S-C-T METER

1.0 INTRODUCTION

This procedure presents steps to calibrate and maintain the YSI Model 33 S-C-T meter. Operation principles, procedures, and equipment specifications are presented in Procedure 5617002 and are not repeated here.

2.0 CALIBRATION

2.1 Temperature

2.1.1 Temperature Knob Setting

It is possible for the temperature knob to become loose or slip from its normal position. In an emergency, the dial can be repositioned. It must be emphasized that this is an emergency procedure only and that the instrument should be returned to the factory for proper recalibration - at the earliest opportunity.

To recalibrate the temperature setting:

1. Red line instrument and then place probe in sample of known conductivity.
2. Read and record the temperature and conductivity of the solution using appropriate settings. Leave probe in solution.
3. Determine the salinity of the solution by running a line vertically on Figure 1 until it intersects the appropriate 'C' line. From this intersection, extend a line horizontally to the left edge of the graph (Figure 1). This determines the salinity of the sample.

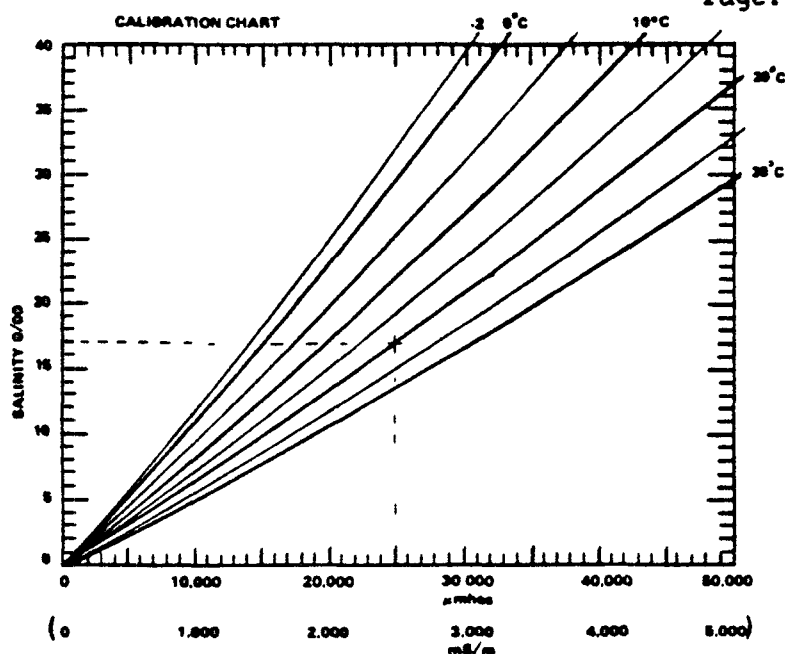


Figure 1. Calibration Chart for Resetting Temperature Knob

4. Remove the 'C knob switch to SALINITY, and turn the control shaft until the meter needle indicates the salinity value determined in step 3.
5. Switch to TEMPERATURE. If this temperature is the same as step 2, continue. If not, repeat steps 1 through 5.
6. Place the knob on the control shaft - without turning the control shaft - with the pointer at the same temperature as the meter reading. Tighten both sets of screws securely. Care must be taken at this step so that the shaft setting is not moved.
7. Return the instrument to the factory at the earliest opportunity.

2.1.2 Temperature Probe/Instrument

To check the accuracy of the Probe/Instrument temperature readings:

1. Place NBS traceable thermometer in solution with thermometer and probe.
2. Place instrument in temperature mode after zeroing and red lining the instrument.

3. After five minutes, compare temperature of thermometer and instrument. If the instrument varies by $\pm 1^{\circ}\text{C}$, the instrument should be returned to the factory for calibration and maintenance.

2.2 Probe Cell Calibration

The YSI #3300 Series Cells are calibrated to absolute accuracy of ± 1.5 percent based on a standard solution of 0.01 molal KCl. To prepare this solution:

1. In a one liter flask, dissolve 0.745 grams of pure dry KCl until the solution is one kilogram in weight.
2. Use Table 1 and the temperature of the water to determine the conductivity of the solution just prepared. Note: Table 1 shows conductivity as if the distilled water was nonconductive. Since even high purity distilled water is slightly conductive, the measured conductivity will be higher by an amount equal to the water's conductivity.
3. Place probe in solution and measure conductivity. The conductivity of the solution plus the conductivity of the distilled water should not vary from the meter reading by $\pm 1.5\%$. If the reading is greater than 1.5% , clean the probe and then recheck the conductivity. If after cleaning it is not possible to measure the conductivity of the calibration solution within $\pm 1.5\%$, the probe and instrument should be returned to the manufacturer for calibration and maintenance.

3.0 MAINTENANCE

3.1 Batteries

The batteries should be replaced either (1) when it is not possible to red line the instrument, (2) after 200 hours of operation, or (3) every 6 months to reduce the danger of corrosion due to leaky batteries.

To replace batteries, remove the six screws from the rear plate. The battery holders are color coded. The positive (+ button) end must go on red.

Use two "D" size alkaline flashlight cells (Eveready E95 or equivalent).

3.2 Probe

3.2.1 Cleaning

When the cell test indicates low readings, the probable cause is dirty electrodes. Hard water deposits, oils, and organic matter are the most likely contaminants.

TABLE 1 - CELL CALIBRATION DATA

Temperature (°C)	Conductivity (umhos/cm)
15	1141.5
16	1167.5
17	1193.6
18	1219.9
19	1246.4
20	1273.0
21	1299.7
22	1326.6
23	1353.6
24	1380.8
25	1408.1
26	1436.5
27	1463.2
28	1490.9
29	1518.7
30	1546.7

Procedure: 6617002
Revision: 0
Date: 4/85
Page: 5 of 6

For convenient normal cleaning, soak the electrodes for 5 minutes with a locally available bathroom tile cleaner such as: "Rally, Tile, Porcelain, and Chrome Cleaner"; Johnson Wax "Envy, Instant Cleaner"; or Lysol Brand "Basin, Tub, Tile Cleaner".

For storage cleaning, a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol, and 1 part HCl can be used.

Always rinse the probe in distilled water after cleaning and before storage.

CAUTION: Do not touch the electrodes inside the probe. Platinum black is very soft and can be scraped off.

If cleaning does not restore the probe performance, re-platinizing is required.

3.2.2 Probe Replatinizing

1. Equipment required:

- a. YSI #3140 Platinizing Solution, 2 fluid ounce (3% platinum chloride dissolved in 0.025% lead acetate solution)
- b. YSI Model 33 meter
- c. 50 ml glass beaker or equivalent
- d. Distilled water

2. Procedure

- a. Clean probe as in section 3.2.1 - either method

- b. Place the cell in the beaker and add sufficient YSI #3140 solution to cover the electrodes. Do not cover the top of the probe
- c. Plug the probe into the Model 33 and switch to the X100 scale to platinize the electrode
- d. Move the probe slightly to obtain the highest meter reading and continue platinizing for the appropriate time shown below:

<u>Meter Reading</u> (umhos/cm)	<u>Time</u> (minutes)
30,000	5
25,000	6
20,000	8
15,000	11
10,000	16

- e. After the elapsed time, remove the probe and rinse in distilled water.
- f. Return the solution to its container. Two ounces of solution should be sufficient for 50 treatments.

3.2.3 Storage

It is best to store conductivity cells in deionized water. Cells stored in water require less frequent platinization. Any cell that has been stored dry should be soaked in deionized water for 24 hours before use.

CALIBRATION AND MAINTENANCE PROCEDURES HAAKEBUCHLER pH STICK

1.0 INTRODUCTION

This procedure presents the steps for calibrating and maintaining the HaakeBuchler pH Stick. Instrument operation principles and procedures and specifications are presented in Procedure 5617003.

2.0 CALIBRATION

2.1 Calibration Solutions

The instrument requires distilled water, a pH 7 buffer solution, and a pH 4 buffer solution for calibration. To prepare the buffer solutions, dissolve the buffer powders provided with the instrument into the volume of distilled water specified on the buffer powder packets. (Note: the manufacturer does not specify whether buffer and pH 4 solutions, other than that provided, may be used as substitute solutions).

The pH of the buffer and pH 4 solutions will vary with the temperature of the solution. Use the table below to determine solution pH based on temperature.

Temp	0°C	10°C	20°C	25°C	30°C	40°C	50°C
pH 4	4.00	4.00	4.00	4.01	4.02	4.04	4.06
pH 7	7.11	7.06	7.01	7.00	6.98	6.97	6.97

2.2 Calibration Procedure

The instrument requires calibration in the field prior to each use. However, as a check of proper instrument function, the instrument should be periodically calibrated in the laboratory,

particularly if the instrument has been stored for an extended period without use.

To calibrate the instrument:

1. Remove the protective sheath and rinse the electrode in distilled water.
2. Place the electrode in the pH 7 buffer solution, depress the white operation button below the LCD display and allow the reading to stabilize.
3. Adjust pH 7 control using the tool on the end of the protective sheath. The pH 7 control is the upper most white control on the right side of the instrument. Adjust the pH control until the meter reads pH 7.
4. Rinse the electrode in distilled water.
5. Place the electrode in pH 4 solution, depress the white operation button, and allow the reading to stabilize.
6. Adjust the slope control (white control below pH 7 control on the right side of the instrument) until the meter reads the correct value of the pH 4 solution.
7. Rinse the probe in distilled water.
8. Repeat steps 2 through 7.
9. Record calibration on the instrument log form.
10. Store instrument properly.

3.0 MAINTENANCE

3.1 Storage

To maintain high accuracy and to obtain a long electrode life, the pH stick must be stored correctly when not in use. Always rinse the electrode in distilled water before replacing it in its protective sheath. The electrode must not be let to dry out.

Procedure: 6617003
Revision: 0
Date: 4/85
Page: 3 of 3

The absorbent pad at the bottom of the sheath must be kept saturated with a pH 7 buffer solution. If this is not available, distilled water can be used as a temporary measure. Replace distilled water with buffer solution at the earliest possible opportunity. Always place buffer (or distilled water) into sheath following each use.

To retain accuracy and speed of response, the insulation of the connectors on the electrode and the body must be kept clean and dry. This is best assured by not unnecessarily removing the electrode from the body.

When not in use, place the pH stick in the wallet provided and store in a dry place.

3.2 Electrode Cleaning

If rinsing the electrode in distilled water is not deemed sufficient to clean the electrode, it can be cleaned in a N/10 HCl acid solution. Following cleaning in the acid, the electrode should be soaked in a pH 7 buffer solution for 24 hours before rinsing. Record cleaning on instrument's log form.

3.3 Battery

Normal battery life is in excess of 200 hours of continuous use. Cells should be replaced at 2 year intervals or earlier if exhausted (voltage per cell of less than 1.35V). Replacement cells must be mercury type V312H or direct equivalent. When refitting cells, make sure they are refitted in the manner illustrated on the battery housing.

CALIBRATION AND MAINTENANCE PROCEDURES FOR GASTECHTOR HYDROCARBON SURVEYOR,
MODEL 1314

1.0 INTRODUCTION

Procedures for calibrating and maintaining the GasTechtor Hydrocarbon Surveyor are presented in this document. Operational procedures and instrument specifications are presented in Procedure 5607004.

2.0 CALIBRATION

2.1 Equipment

1. Combustible gas in air (hexane at 40 percent LEL)
2. Combustible gas in zero air (375 ppm hexane)
3. Calibration valve
4. Flow meter with tube connector
5. Calibration cliplock
6. Humidifier (for ppm calibration)
7. Screwdriver with small head to adjust potentiometers

2.2 Combustibles Calibration

2.2.1 LEL Calibration

To check and adjust calibration on a known gas sample:

1. Turn instrument on and allow it to warm up and stabilize (approximately five minutes). Be sure batteries are charged sufficiently to read above check mark.
2. Place instrument in LEL mode - control switches out.
3. Open instrument case by loosening captive screw at front. Lift upper half of case slightly, move 1/4 inch to rear to disengage rear clamp; then separate the two halves. Locate COARSE ZERO potentiometer on underside of circuit board (marked "Zero").

4. Turn external PPM/LEL Zero control to center of its span. Then turn COARSE ZERO potentiometer to bring meter to zero reading.
5. To calibrate the LEL range:
 - a. Insert sample inlet tube into a vessel on other source of known calibration gas with LEL concentration. Open valve.
 - b. Watch meter and note highest reading. If it is correct, turn LEL span potentiometer on circuit board to give desired reading.
 - c. Close valve on calibration gas and remove tubing.
6. If zero cannot be adjusted, or if reading cannot be set high enough, replace the detector.

2.2.2 PPM Calibration

For PPM calibration, follow the same procedure as for LEL calibration, but with the range (mode) switch in the PPM position.

1. Set instrument in PPM mode, allow five minutes for warmup (if not previously done).
2. Turn external PPM/LEL Zero control to center of span. Open instrument box and adjust PPM span potentiometer on circuit board until meter reads zero.
3. Attach (or replace) calibration gas in PPM concentration to inlet tube and open valve.
4. Watch meter and note highest reading. If it is incorrect, adjust PPM span potentiometer on circuit board to give desired reading.
5. Turn off valve and remove tubing.
6. If zero cannot be adjusted or the reading cannot be set high enough, replace the detector.

Note: In the sensitive ppm range, it is important that the humidity of the sample be the same as that of

the air used for zero adjustment. If they are different, a significant offset in zero reading may be observed. To overcome this, a humidifier may be used for both zero and calibration tests, providing the calibration gas is one that will not be absorbed in water.

To calibrate PPM using a humidifier:

1. Turn on instrument, place in PPM mode, allow to warm up, and adjust zero in normal way (as described above).
2. Add a few drops of water to glass wool packing inside humidifier. Glass wool should be moist, but not dripping.
3. Couple flowmeter to cliplock fitting, and humidifier to flowmeter inlet, as shown in Figure 1.
4. Couple cliplock fitting to instrument inlet.
5. Readjust zero as necessary as instrument stabilizes.
6. Note flowmeter reading.
7. Connect calibration valve to ppm-range cylinder. Open valve slightly to produce a small flow.
8. Couple valve outlet to humidifier inlet.
9. Adjust valve to give same flow on flowmeter as observed in step 6.
10. Watch meter as gas enters instrument. Observe highest reading and compare with marked gas concentration on cylinder.
11. If reading is not correct, adjust PPM span potentiometer on circuit board so that reading reflects PPM span gas concentration.

2.2.3 Combustibles Alarm Threshold

The reading at which the alarm is actuated in each range can be set by use of the corresponding ALARM Threshold potentiometer on the circuit board. The potentiometers

should be adjusted so that the LEL alarm is activated at 20 percent LEL and the PPM alarm at 100 ppm.

To adjust the LEL range alarm:

1. Turn instrument on, place in LEL mode, and allow to warm up.
2. Adjust PPM/LEL Zero adjust knob on instrument so that the meter is on 20 percent LEL. (This may require adjusting the Coarse Zero potentiometer.)
3. Adjust the LEL Alarm Threshold potentiometer on the circuit board to the point where the alarm is just activated. Clockwise rotating will lower the alarm setting.
4. Verify the alarm setting by turning LEL/PPM Zero control to bring meter indicator in and out of the alarm zone.
5. Re-zero instrument.

To adjust the PPM alarm:

Follow the same steps as above for LEL alarm adjust, but:

1. Set instrument in PPM mode.
2. Set meter needle at 100 ppm using Zero control knob.
3. Adjust PPM Alarm Threshold potentiometer to point where alarm just activates.
4. Verify alarm action and re-zero as above.

2.3 Oxygen Adjustments

2.3.1 Oxygen Zero Adjustment

The following steps should be employed with the OXY - PPM/LEL switch in the depressed position (i.e., OXY in position). To check and adjust zero or a known oxygen free sample.

1. While instrument case is open, identify oxygen ZERO potentiometer, which is located on the oxygen (uppermost) circuit board. This potentiometer is located through the right (or uppermost) hole on the lower circuit board. This is not the potentiometer on the lower circuit board used for LEL and PPM zero adjustments.
2. Attach instrument inlet tube to know oxygen free sample. Open valve of oxygen free source.
3. Watch meter carefully. If reading does not go exactly to zero, adjust it by turning the oxygen zero potentiometer. Counterclockwise rotation will decrease reading.
4. If zero adjustment cannot be made, have oxygen all reactivated.
5. After zero adjustment has been completed, return hose inlet to normal atmospheric air. Readjust the OXY CAL control on instrument as necessary to bring meter to 21 percent oxygen.
6. If reading cannot be set high enough, have oxygen cell reactivated.

2.3.2 Oxygen Alarm Threshold

The reading by which the oxygen alarm is activated can be set by the use of the Alarm Threshold potentiometer. This level should be at 19.5 percent.

To set:

1. With instrument in OXY mode, turn OXY CAL knob to bring meter to 19.5 percent oxygen.
2. Locate oxygen alarm threshold potentiometer, on the oxygen or uppermost circuit board. This potentiometer is located through the hole in the lower circuit board adjacent to the LEL Alarm adjustment (or to the left of the oxygen zero potentiometer hole).
3. Turn Oxygen Alarm Threshold potentiometer to the point where alarm just operates. Clockwise rotation will be raise alarm setting.

4. Verify setting by turning OXY CAL control knob to bring meter into and out of alarm zone.

The oxygen high alarm is set by the factory at 25 percent. The potentiometer is located on the upper circuit board. There is not a hole in the lower circuit board to adjust this potentiometer. Should it be determined that this alarm is out of adjustment and that the alarm is not being activated, the high alarm potentiometer can be adjusted by removal of the lower circuit board. The high alarm potentiometer is the one closest to the rear. Adjustments to this potentiometer are the same as for the low alarm threshold as described above.

3.0 MAINTENANCE

3.1 Batteries

1. Check battery voltage periodically by pressing BATTERY CHECK switch. Recharge before voltage reaches minimum.

When connecting charger, always follow these steps:

- a. Confirm that the plug is inserted in the correct way, with the THIS SIDE UP label upwards. The socket is polarized, with the pins offset below the centerline, but can sometimes be forced on the wrong way, particularly if it has become worn with use.
 - b. Verify that a charge is actually entering battery. To do this, turn instrument on and check meter reading while BATTERY CHECK button is pressed. Observe reading while charger is plugged and unplugged at wall socket. If reading increases when charger is connected, and decreases when unplugged, battery is receiving a charge. If no change is observed, then probably charger or power circuit is at fault. If charger is defective return it for repair or replacement.
2. If sufficient voltage cannot be obtained after charging, open instrument and:

- a. Check voltage output with a voltmeter, between red and black wires (unplug connector to gain access to pins). Voltage should be about 8.5 volts.

If voltage is acceptable, but volt check reading is too low, meter or switch could be at fault. If voltage is too low, battery is at fault.

- b. If no output voltage can be obtained, check fuse by unscrewing recessed cap, marked "FUSE", and removing fuse. It can be checked visually or with an ohmmeter. If burned out, replace with a new one, but be sure to attempt to identify the cause of the overload or short circuit. Fuse must be type 3AG-1A.
 - c. If battery voltage is too low, and cannot be brought up by overnight charging, the battery probably needs replacement. To remove, take out the two screws holding it to bottom of case, and unplug black and orange wire connector at charging end.
3. If the replaceable cell battery pack has been installed and is found defective, open the pack and check the voltage of each individual cell with a voltmeter. Remove two screws on the top of the pack with a 1/8" Allen wrench. The lid is spring loaded and may be held down by hand to ease the screw removal. Carefully remove the lid and the individual cells.
 - a. The cells supplied are the Stock No. 49-1501 rechargeable D-size nickel-cadmium type, 3.5-4.0 AH, and when charged, measure about 1.35 volts. Discard and replace faulty cells.

NOTE

In an emergency situation, the rechargeable nickel-cadmium cells may be replaced by the common alkaline or carbon type D-size cell but under no circumstances may two types be mixed in a battery. The cells must all be of the same type: nickel-cadmium, carbon or alkaline.

CAUTION

If disposable type cells are used, unplug the charging circuit connector (orange and black wires). Carbon or alkaline type cells are not rechargeable and any attempt to do so may cause damage to the instrument.

- b. Examine the battery cavity and carefully clean out all foreign substances. Re-insert the cells into the pack in accordance with the diagram on the lid. (Negative end to springs, button end to rivets.) Leave the proper space open for the fuse cartridge.
- c. Place the lid onto the cells, press down firmly and insert screws. The convoluted case will assure cell alignment. Tighten the screws snugly, do not overtorque. It may be necessary to spring sides of instrument case apart slightly to clear battery lid.
- d. Join all loose connectors, re-assemble instrument and charge battery as required.
- e. If normal operation from disposable batteries is desired, use the Stock No. 45-8052 battery pack instead of the 49-8051 pack. This assembly has a quick change feature, a retainer strap which can be pushed aside with thumb pressure to release the lid and give access to the cells. This battery pack has no charger connection, so there is no danger of inadvertent charging of disposable cells. it can be used with rechargeable cells, but they must be charged separately.

3.2 Combustibles Detector

- 1. Sensor assembly may require replacement if:
 - a. Meter cannot be set to zero within range of ZERO potentiometer. (Including COARSE ZERO.)
 - b. Meter cannot be set to desired level within range of SPAN Adjust, either range.
- 2. To replace detector:
 - a. Open instrument case.
 - b. Unscrew the red, green and white wires at terminals on main circuit board, noting color coding.
 - c. Unscrew knurled retaining cap at reaction chamber.
 - d. Pull out original detector and install new one, being sure that O-ring is in place, under flange of detector.
 - e. Connect wires to terminals, turn power on, and adjust COARSE ZERO as in Sect. 2.2.1.

3.3 Oxygen Detector

1. Oxygen sensor assembly may require repair if:
 - a. Meter cannot be set to desired level within range of OXY CAL Adjust.
 - b. Meter cannot be set to zero within range of ZERO potentiometer.
2. If oxygen sensor assembly requires repair, it should be sent to factory for reactivation. Alternatively, a complete new detector can be ordered, on an exchange basis.

Oxygen cell is an electrochemical device similar to a battery, which gradually depletes itself, regardless of usage of the cell. It requires periodic reactivation, consisting of replacement of the electrolyte and the membrane, plus cleaning and inspection of the electrodes. This is most economically done at the factory.

New or reactivated cells are guaranteed usable for six months, and any cells returned for reactivation within that time period will be inspected and tested for operability. If found to have failed prematurely, they will be reactivated at not charge. Cells are date-coded.

To replace oxygen sensor:

- a. Open instrument case. Locate oxygen cell.
- b. Swing retainer clamp clockwise and remove it to release cell.
- c. Tilt cell upward and pull it out of case. Unplug cell wire at socket.
- d. Reinstall newly reactivated cell in same position. Before installing, remove protective seal from face of cell, and shake out any drops of water that remain.

3.4 Meter

If meter is damaged, it can be removed for repairs or replacement, as follows:

Procedure: 6607004
Revision: 0
Date: 3/85
Page: 10 of 11

1. With upper half of instrument removed from lower half and inverted, loosen internal lock nuts from POWER and BATTERY CHECK switch bushings and PPM/LEL ZERO potentiometer bushing.
2. Remove external lock nut from PPM/LEL ZERO potentiometer. (First remove knob, if one is used.)
3. Remove external face nuts from switch bushings.
4. Remove three screws holding circuit board into case.
5. Remove two nuts from meter studs.
6. Pull circuit board out of case as far as connecting wires permit.
7. Lift out meter.

3.5 Buzzer

If buzzer fails, it can be removed by first taking out circuit board (steps 3.4) and unsoldering red and black wires at board. Then remove retaining screws and nuts.

Note: Before removal, first verify that buzzer is actually defective. Connect to a 6 volt battery (Red +, Black -). A good buzzer will give a steady tone.

3.6 Circuit Board

Main circuit board can be removed by steps 2.3.2, plus disconnection of pump and detector wires at terminals. This allows the board to be pulled out of the case and put aside for access to the oxygen circuit board. However, it will remain connected to the oxygen board until the interconnecting wires are unsoldered.

Procedure: 6607004
Revision: 0
Date: 3/85
Page: 11 of 11

Preferably, both boards will be removed as a unit, and returned to factory for repairs. To complete removal, loosen internal lock nuts, remove external lock nuts from remaining controls, and take off the hex plastic spacers which hold oxygen board in place.

3.7 Filter

The filter element in inlet fitting is pressed in but can be pushed out and replaced. When necessary, the complete fitting can be replaced.

3.8 Pump

Pump used is a diaphragm type, driven by a brushless DC motor. It should have long life, several years in normal operation, but it may lose efficiency if dirt is drawn in and collects under the valves. Verify proper pump operation periodically by taking a sample and observing time for initial gas response to occur. This should be within 5 seconds for a 10 foot hose. It may also be checked with the flowmeter provided as a calibration accessory. Flow should be 2.0 cfh or greater.

If pump needs servicing, it can be removed by taking out the clamp retaining screw which extends through case bottom. Pump can be returned for repair on an exchange basis or it can be disassembled and cleaned. Replacement pump head assemblies and diaphragms are available.

4.0 REFERENCE

Gastech, Inc. No date. Instruction Manual, GasTechtor hydrocarbon super surveyor, Model 1314. (3188-101283-0).

CALIBRATION AND MAINTENANCE PROCEDURE
GCA MINIRAM PARTICULATE/AEROSOL
MONITOR PDM-3

1.0 INTRODUCTION

This document presents the procedures for calibration and maintenance of the GCA MINIRAM Particulate/Aerosol Monitor PDM-3. Instrument description, specifications, and operating procedures are discussed in document 5607021 and will not be reported here.

2.0 CALIBRATION

The MINIRAM has been factory-calibrated using a representative dust and does not require recalibration for routine use. The instrument can be calibrated to specific particulates or aerosols through actual concurrent collection of particulates on a filter using a personal filter sampler. Such a calibration, as described in the instrument's operation manual, is beyond the scope of normal REM work activities and will not be presented here. If a specific calibration is required or the instrument appears to not function properly, it is recommended that the instrument be returned to the manufacturer for proper calibration.

3.0 INSTRUMENT ZERO

The interior walls of the MINIRAM chamber reflect a small amount of the light from the infrared source into the detector. This background level is referred to as the "zero value" and is automatically subtracted from all aerosol concentration readings during the measurement mode. The result is that the displayed readings depend only on the actual dust concentration present within the sensing chamber.

Procedure: 6607021
Revision: 0
Date: 7/85
Page: 2 of 4

The zero value varies from instrument to instrument as well as with different sensing chambers. It will increase somewhat as the chamber walls and windows become contaminated with dust. A zero update should be performed periodically to correct for this. Also, a zero update should be performed after cleaning the sensor chamber (Section 5.0).

Pressing ZERO during a measurement period provides momentary display of the stored zero concentration used by the MINIRAM to correct all digital concentration readings. To update the ZERO value, the MINIRAM must be in its OFF state. Then press ZERO and wait until the display again indicates OFF.

The average of 4 consecutive 10-second zero level measurements will then be stored by the MINIRAM as the new ZERO reference value. When operating the MINIRAM in high particle concentration environments ($>5 \text{ mg/m}^3$), the zero value update should be performed approximately every 8 hours. At aerosol concentrations below 1 mg/m^3 this update may only be required once a week. The zero update should be performed in a clean air or background environment.

4.0 BATTERY

4.1 Battery Recharging

The battery should be recharged after each 8 hours of usage. A low battery bar on the instrument display will appear to indicate insufficient battery level.

To recharge the battery:

1. Plug charger into A.C. line.
2. Connect charger plug into corresponding MINIRAM receptacle.

3. Leave charger connected to MINIRAM for a minimum of 12 hours before using the instrument without the charger.
4. The instrument can be operated indefinitely when connected to the charger.

4.2 Battery Pack Replacement

The battery pack of the MINIRAM constitutes an intrinsically safe sealed module that can be removed and replaced. To do so, remove the four central screws from the back of the MINIRAM case (not the two corner screws) and gently lift the battery pack up and out, and gently pull apart the battery connector freeing the battery pack. Reverse the order of these steps when installing another pack.

Note: All stored data will be lost when disconnecting the battery.

5.0 MAINTENANCE

When the MINIRAM is not being operated, it should be placed in its plastic bag which then should be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation within and exposure to particulate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero reference following steps in Section 3.0 will correct errors resulting from such particle accumulations, eventually this contamination could affect the accuracy of measurements as a result of excessive spurious scattering and significant alternatives to the radiation passing through the glass windows of the sensing chamber.

Procedure: 6607021
Revision: 0
Date: 7/85
Page: 4 of 4

An indication of excessive chamber contamination is provided by a zero level reading in excess of 3 mg/m^3 .

In order to clean a soiled sensing chamber, remove the chamber by gently pushing it away from the display/control panel end, using both thumbs, slide it out of its channel. Touching of the lense should be avoided. Also the inside surface of the sensing chamber is coated with a special anti-reflectant paint and touching should be avoided. Wash the sensing chamber with soap and water to remove particles. Do not rub interior surfaces of chamber or use solvents of any type. Allow the sensing chamber to dry completely and reinsert into the MINIRAM by inserting the closed end of the chamber first and gently pushing the chamber back into the instrument case.

6.0 REFERENCE

GCA Corporation. 1984. MINIRAM Personal Monitor Model PDM-3 Operation Model.

Procedure: 6617001
Revision: 0
Date: 3/85
Page: 1 of 7

CALIBRATION AND MAINTENANCE PROCEDURE YSI MODEL 57 DISSOLVED OXYGEN METER

1.0 INTRODUCTION

This procedure presents the steps required to calibrate and maintain the YSI Model 57 Dissolved Oxygen Meter. A description of the instruments function and specifications are presented in Procedure 5617001 and are not repeated here.

2.0 CARE OF THE PROBE (YSI 5739 D.O. PROBE)

2.1 Probe and Cable Description

The YSI 5739 probe is designed for use with the 5740 detachable cable. For user convenience, the probe is equipped with a disconnecting cable to facilitate changing cable lengths and replacing damaged cables or probes. The probe and cable assembly are held together by a threaded retaining nut. The connection is not designed for casual disconnection and should only be disconnected when necessary.

2.2 Cable Connection

To disconnect the cable, unscrew the retaining nut and slide it down the cable to expose the connector. Pull gently on the cable and connector until the connector comes away from the probe body.

To reassemble, inspect the connector and "O" ring for cleanliness. If the "O" ring is frayed or damaged, remove it by squeezing it into the groove causing it to bulge, then roll it out of the groove and off the connector. Replace the "O" ring by rolling a new one into place on the probe. Push the connector on the cable into the probe body, rotating it until the two halves

mate. A light coating of vaseline or silicone grease on the "O" ring will make reassemble easier. Air trapped between the connector halves may cause them to spring apart slightly; this is normal. Hand tighten the retaining nut onto the probe.

2.3 Pressure Compensation

The vent on the side of the probe is part of a unique pressure compensation system that helps assure accurate readings at great depths of water. The quantity of air bubbles trapped under the membrane determines how serious the pressure error will be. The system is designed to accomodate a small amount of trapped air and still function properly, but the amount should be kept to a minimum.

The compensation system normally does not require servicing and should not be taken apart. However, if electrolyte is leaking through the diaphragm or if there is an obvious puncture, the diaphragm must be replaced. Using a coin, unscrew the retaining plug and remove the washer and diaphragm. Flush any salt crystals from the reservoir with distilled water. Install the new diaphragm (convoluted side in). Replace the washer and screw in the retaining plug.

2.4 Preparing the Probe (Electrolyte Replacement)

The following steps should be used to fill or replace electrolyte. The instrument should be filled when received from factory, or refilled whenever the membrane needs replacement, bubbles appear in the probe or when electrolyte evaporates.

1. If not already done, prepare electrolyte solution by dissolving the KCl crystals in the O₂ probe solution dropper

Procedure: 6617001
Revision: 0
Date: 3/85
Page: 3 of 7

bottle with distilled water. Fill the bottle to the top and wait until the crystals are thoroughly dissolved.

If factory supplied electrolyte is not available, it can be prepared by making a saturated reagent grade KCl solution with distilled water. Slowly add KCl crystals to approximately 30 ml of distilled water until crystals stop dissolving. Decant 25 ml of the solution into second vial. Add 25 ml of distilled water to decanted solution reducing its concentration by one-half. Adding two drops of Kodak Photo Flo per 100 ml of solution assures good wetting of the sensor, but is not absolutely essential. Place finished solution into the O₂ probe solution bottle or similar container.

2. Unscrew the sensor guard from the probe and then remove the "O" ring and membrane. Thoroughly rinse the sensor with KCl solution.
3. Fill the probe with electrolyte by:
 - a. Grasping the probe in your left hand with the pressure compensation vent to the right and the probe opening at the top.
 - b. Fill the sensor body with electrolyte by pumping the diaphragm with the eraser end of a pencil or similar soft, blunt tool.
 - c. Continue filling and pumping until no more air bubbles appear.
4. To replace the membrane:
 - a. Secure a membrane to the sensor by pressing it near the top of the sensor with your thumb.
 - b. Add additional solution until a large meniscus completely covers the gold cathode. Handle membrane material with care, keeping it clean and dust free; touching it only at the ends.
 - c. With the thumb and forefinger of your other hand, grasp the free end of the membrane.
 - d. Using a continuous motion, stretch the membrane up, over, and down the other side of the sensor. Stretching forms the membrane to the contour of the probe.

- e. Secure the membrane under the forefinger of the hand holding the probe.
 - f. Roll the "O" ring over the end of the probe. There should be no wrinkles in the membrane or trapped air bubbles. Some wrinkles may be removed by lightly tugging on the edges of the membrane below the "O" ring.
 - g. Trim off excess membrane with scissors and a sharp knife. Check that the stainless steel temperature sensor is not covered by excess membrane.
- 5. Shake off excess KCl.
 - 6. Replace the sensor guard.
 - 7. A bottomless plastic bottle is provided with the probe for probe storage. If not already done, place a moist towel or sponge on the bottle and insert probe in open end. This keeps the electrolyte from evaporating.
 - 8. Place a calibration label on the probe indicating date of electrolyte/membrane replacement.
 - 9. Complete equipment log form (F6101) to indicate adjustments and repairs made.

2.5 Probe Maintenance

1. Membranes

Membranes should be replaced after every two to four weeks of usage. The membrane will last indefinitely if not used. However, if the electrolyte evaporates and an excessive amount of bubbles form under the membrane, or the membrane becomes damaged, thoroughly flush the reservoir with KCl and install a new membrane (see steps 2.4).

2. Gold Cathode

- a. The gold cathode should always be bright and untarnished. To clean, wipe with a clean lint free cloth or hard paper. Never use any form of chemical or abrasive material. Rinse the sensor several times with KCl, refill, and install in new membrane (see steps 2.4).
- b. Some gases contaminate the sensor, evidenced by discoloration of the gold. If the tarnish cannot be

removed by vigorous wiping with a soft cloth, lab wipe, on hard paper, return the probe to the factory for service.

- c. If the probe has been operated for extended periods with a loose or wrinkled membrane, the gold cathode may become plated with silver. In this event, the probe should be returned to the factory for refinishing.

3.0 INSTRUMENT CALIBRATION

3.1 Probe Calibration

The instrument must be calibrated in the field prior to each field use because changes in temperature and altitude affect instrument response. However, a laboratory calibration should be performed following replacement of electrolyte and membrane as a check of proper instrument response. A modified Winkler Titration Technique will be used for laboratory calibration. To calibrate the instrument:

1. Draw an approximately 1500 ml sample from a common source. Divide the sample equally into four samples.
2. Determine the oxygen in three samples using the Winkler Titration Technique and average the three values. If one of the three values differs from the others by 0.5 mg/l, then discard that value and average the other two.
3. Place the D.O. probe in the fourth sample and stir.
4. Set the salinity control to zero or to the appropriate salinity value of the sample.
5. Switch the D.O. meter to the desired mg/l range.
6. Allow the probe to remain in the water sample for a minimum of two minutes before adjusting the CALIBRATE knob.
7. Adjust the CALIBRATE knob to the average value as determined in step 2.

Procedure: 6617001
Revision: 0
Date: 3/85
Page: 6 of 7

8. Leave probe in sample for an additional two minutes to verify the stability of the observed reading. Readjust the knob as necessary.
9. Record calibration activity in equipment log form (F6101).

3.2 Temperature Probe Calibration

1. Place meter knob in temperature position.
2. Submerge probe and NBS-traceable thermometer in water that is in temperature range of instrument.
3. Wait at least 10 minutes for temperature stabilization.
4. Read temperature of instrument reading and compare to that of the NBS-traceable thermometer. Record both values in equipment log form (F6101).
5. Temperature readings for instrument and thermometer should be within $\pm 1^{\circ}\text{C}$. If not, that instrument should be removed from use and the probe replaced, or return the instrument to the manufacturer if the instrument cannot be calibrated with a new probe.

4.0 POWER SUPPLY AND BATTERIES

The instrument is powered by two "C" size carbon zinc cells located inside the instrument on the meter end. The instrument does not have a low battery indicator, but the batteries should be replaced when the Red Line knob is at its extreme adjustment, or at least annually. The amount of remaining adjustment is an indication of the battery condition.

The batteries are replaced by removing the screws on the rear cover of the instrument and removing the two batteries at the end of the instrument near the meter. When installing the new batteries, the plus (+) end fits into the battery holder.

Procedure: 6617001
Revision: 0
Date: 3/85
Page: 7 of 7

5.0 INSTRUMENT TROUBLESHOOTING

1. Erratic or inconsistent readings can be caused by a defective membrane or air bubbles in the electrolyte. Replace membrane and electrolyte to correct problem.
2. Water in the connector plugs can cause erratic readings. Check plugs for water and dry if found wet.
3. H₂S, SO₂, halogens, neon, NO, and CO are interfering gases. If you suspect erroneous readings, it may be necessary to determine if these are the cause.